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MINIDOKA DAM
WILDLIFE IMPACT ASSESSMENT

Final Report

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

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EXECUTIVE SUMMARY

Under direction of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501), and the subsequent Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, a wildlife impact assessment has been developed for the U.S. Bureau of Reclamation's Minidoka Dam and Reservoir in south central Idaho.

This assessment was conducted to fulfill requirements of Section 1003(b)(2) of the Fish and Wildlife Program. Specific objectives of this study included the following:

1) Select target wildlife species, and identify their current status and management goals.

2) Estimate the net effects on target wildlife species resulting from hydroelectric development and operation.

3) Recommend protection, mitigation, and enhancement goals for target wildlife species affected by hydroelectric development and operation.

4) Consult and coordinate impact assessment activities with the Northwest Power Planning Council, Bonneville Power Administration, U.S. Bureau of Reclamation, Bureau of Land Management, Shoshone-Bannock Tribes, U.S. Fish and Wildlife Service, Pacific Northwest Utilities Conference Committee, and other entities expressing interest in the project.

The interagency team of biologists used the Habitat Evaluation Procedure (USFWS 1980b) to estimate hydroelectric impacts to wildlife in terms of Habitat Units. For a given species, one HU is equivalent to one acre of prime habitat. The interagency team chose target species to represent a broad spectrum of wildlife and habitats affected by the hydropower facility. The species were chosen because they are of high priority according to state or federal programs, and/or because they are indicator species used to describe habitat conditions for groups of species with similar habitat needs. For each target species evaluated, the interagency team estimated the effects of the project on the species', habitat quality measured with the Habitat Suitability Index (HSI). An HSI is a number between 0 and 1.0. It is a numerical index that represents the capacity of a given habitat to support a selected fish or wildlife species. Species models, comprised of measurable habitat variables, were used during HSI determination. Habitat Units for a given target species were calculated by multiplying its HSI times the acreage in the study area providing habitat for the species.

A total of 12,414 acres was quantified by cover type in the study area for pre- and post-construction conditions. The pre-construction study area contained mostly sagebrush-grasslands (7,990 acres) in the upland area inundated. It also supported a riparian corridor containing 33.6 miles of the Snake River, 2.6 miles of the Raft River, and an estimated 935 acres of emergent and willow-dominated wetlands. Many islands existed in the river channel. The Snake River was uncontrolled in the early 1900's, and flood flows were certainly greater than flows that occur now.

The present-day study area is primarily lacustrine, with an estimated 4,376 acres of submerged plant beds. The shoreline of Minidoka Reservoir supports 362 acres of emergent and willow-dominated wetlands. Several islands exist within the reservoir. The 150-acre spillway area below the dam contains a complex of wetlands, uplands, and islands that are valuable wildlife habitat.

The interagency work group's assessment of impacts to target wildlife species showed a nest loss of 5,374 HU's in the Minidoka Dam and Reservoir study area. Although some aspects of the dam and reservoir have been positive, the overall impact has been negative, and these impacts have contributed to wildlife problems in the general area. As a result, the interagency work group agreed that a mitigation plan should be developed for Minidoka Dam and Reservoir. The goal of this plan is to compensate for the losses identified in the study area. At this time, the work group believes mitigation efforts should be focused on target species that were adversely affected in the Minidoka Reservoir study area. The work group further believes that mitigation priorities and specific management proposals should be determined during development of a mitigation plan.

Summary of Minidoka Dam and Reservoir impacts to target species in the study area.[1]

	Pre-construction			Post-construction			Net impact	
Target species	Acres	HSI	HU's	Acres	HSI	HU's	Acres	HU's
Mallard	3,660	0.20	732	4,528	0.20	906	+868	t174
Redhead	332	0.72	239	6,735	0.70	4,714	+6,403	+4,475
Western grebe	-	-		321	0.85	273	t321	t273
Marsh wren	935	0.06	56	325	0.81	263	-610	+207
Yellow warbler	433	0.87	377	37	0.95	35	-396	-342
River otter	3,897	0.80	3,118	125	1.0	125	-3,772	-2,993
Mule deer	8,925	0.41	3,659	616	0.40	246	-8,309	-3,413
Sage grouse	7,990	0.47	3,755	-	-	-	-7,990	-3,755
Total net impact (HU's)								-5,374

[1] Study area for these impacts was from the lower end of Minidoka spillway upstream to the upper end of Minidoka Reservoir. Impacts were assessed within the boundary of the reservoir and spillway high water lines, plus areas where wetlands have become established around the reservoir and spillway. The mallard evaluation area included a 100 meter band of upland nesting habitat adjacent to the edge of wetlands.

INTRODUCTION

The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Public Law 96-501) directed that measures be implemented to protect, mitigate, and enhance fish and wildlife to the extent affected by development and operation of hydropower projects in the Columbia River Basin. This Act created the Northwest Power Planning Council, which in turn developed the Columbia River Basin Fish and Wildlife Program. This Program established a four-part process:

1) Wildlife Mitigation Status Reports -- to identify mitigation proposed, mitigation required, mitigation implemented, and current studies and planning:

2) Wildlife Impact Assessments -- to quantify wildlife and habitat impacts using the best scientific information available:

3) Wildlife Protection, Mitigation, and Enhancement Plans -- to provide a plan to mitigate wildlife and habitat losses pursuant to Sections 4(h)(5), (6), and (10a) of the Northwest Power Act:

4) Implementation of mitigation projects -- to protect, mitigate, and enhance wildlife to the extent affected by development and operation of hydroelectric facilities.

This wildlife impact assessment for the Minidoka Hydroelectric Facility was developed to fulfill requirements of Section 1003(b)(2) of the Columbia River Basin Fish and Wildlife Program. Specific objectives of this study included the following:

1) Select target wildlife species, and identify their current status and management goals.

2) Estimate the net effects on target wildlife species resulting from hydroelectric development and operation.

3) Recommend protection, mitigation, and enhancement goals for target wildlife species affected by hydroelectric development and operation.

4) Consult and coordinate impact assessment activities with the Northwes't Power Planning Council, Bonneville Power Administration, U.S. Bureau of Reclamation, Bureau of Land Management, Shoshone-Bannock Tribes, U.S. Fish and Wildlife Service, Pacific Northwest Utilities Conference Committee, and other entities expressing interest in the project.

Agencies that actively participated in work sessions included the U.S. Bureau of Reclamation (USBR), U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), Shoshone-Bannock Tribes, and Idaho Department of Fish and Game (IDFG). Throughout the assessment, we consulted and coordinated with the above agencies and tribes, Bonneville Power Administration (BPA), Northwest Power Planning Council, and Pacific Northwest Utilities Conference Committee. This report was funded by BPA.

FACILITY DESCRIPTION

The facility's features and original authorized purposes were described in the Minidoka Dam and Reservoir Mitigation Status Report (Martin and Mehrhoff 1985):

> Minidoka Dam is on the Snake River, 10 miles northeast of Rupert, Idaho. The dam backs water up the Snake River nearly to Eagle Rock, about 7 river miles below American Falls Dam. At the normal full pool level (elevation 4,245 feet), the reservoir is about 34 miles long, up to 1.7 miles wide, and 11,850 acres in size. The reservoir is known as Lake Walcott.
>
> The reservoir has a storage capacity of 210,000 acre-feet. The dam impounds 95,200 acre-feet of active storage for power production and the irrigation of about 120,000 acres of farmland (USFWS 1980a). Irrigation releases are made between April and November. Reservoir elevation during this period is 4,245 feet. It is lowered to 4,240 feet by the first part of December to prevent ice damage to the spillway flashboards (USBR 1981a).
>
> The dam is 86 feet high, with a crest length of' 4,475 feet. Of the structure's total crest length, a zoned earth and rock-filled section occupies 670 feet, the power plant occupies 150 feet, an earthen dike occupies 800 feet, and the overflow spillway occupies 2,385 feet; the remainder includes the canal headworks, administration building, and the switchyard (USBR 1981b).
>
> The power conduits have a capacity of 4,850 cubic feet per second (cfs). The power plant has a maximum capacity of 15.8 megawatts. The spillway is a combination of four lo-foot by 12-foot radial gates and an uncontrolled overflow weir consisting of 5-foot-high flashboards (USBR 1981b). The spillway flows average 4,000 to 5,000 cfs during summer (USBR 1982). However, spills in excess of 20,000 cfs have occurred (USBR 1981b). The total capacity of the spillway, the outlet works, and the diversion works is rated at 113,125 cfs (USBR 1981c).
>
> Minidoka Dam was authorized in 1904, by the Secretary of the Interior, under the Reclamation Act of 1902. Dam construction began in 1904, and was completed in 1906. In 1908, construction began on the first federal hydroelectric power plant in the northwest. In 1909, it was supplying power for pumping water to lands south of the Snake River.
>
> The original authorized purposes were for irrigation and power production. The Secretary of the Interior authorized Minidoka Dam after he concluded that the Director of the Geological Survey had proven the project to be feasible. The Director's report stated that "it is possible to irrigate by gravity about 68,000 acres of good land: in addition, it is possible to generate over 10,000 horsepower, which can be used to pump and supply water to about 53,000 acres of land lying above the gravity canals" (USBR 1949).

By Executive Order in 1909, President Theodore Roosevelt created the management area known now as the Minidoka National Wildlife Refuge **(NWR).** He named it the Minidoka Reservation, and established it for the purpose of protecting native birds.

STUDY AREA

The area evaluated for impacts to wildlife extended from the lower end of Minidoka spillway (river mile 674.7) upstream to the end of the reservoir (river mile 707.0), about 1.4 river miles below Eagle Rock, and 7 miles below American Falls Dam (Figure 1). The study area for all species except the mallard included the reservoir and spillway area, plus wetlands that have become established around the reservoir and spillway. The mallard assessment area included a 100-meter (109-yard) band of upland nesting habitat adjacent to study area wetlands.

Vegetation communities and other features in the study area and vicinity have been described by CH2M Hill (1982), USBR (1982), Leptich (1987), and Bodhurtha (1988). Eleven cover types (i.e. plant communities or land use features) were identified as occurring in the pre- and/or post-construction areas that were evaluated. Definitions in Cowardin et al. (1979) were used to describe wetlands. Upland cover types were classified generally following USFWS (1980c). Each cover type is briefly described below.

Emergent wetland. This cover type occurs in areas flooded or saturated during some portion of the year. These areas are characterized by erect, rooted, herbaceous hydrophytes. In the study area, cattails (spp.), bulrushes (*Scirpus* spp.), sedges (*Carex* spp.), and various grasses may dominate, depending on the water regime.

Deciduous scrub-shrub wetland. This wetland type is located where moisture is abundant, usually along rivers and tributaries. Dominant woody vegetation is less than 6 meters (20 feet) in height. In the study area, willows (*Salix* spp.) are the dominant shrubs.

Deciduous forested wetland. This wetland type also occurs where moisture is abundant. Woody vegetation is equal to or greater than 6 meters (20 feet) in height. In the study area, black cottonwood (*Populus trichocarpa*) is the dominant tree.

Lacustrine. The reservoir pool.

Riverine. The river channels.

Sagebrush-grassland (evergreen shrubland). In the study area, this type is dominated by basin big sagebrush (*Artemisia tridentata* subsp. *tridentata*) and Wyoming big sagebrush (*A. tridentata* subsp. *wyomingensis*). A wide variety of grasses and forbs occur in this community.

Grassland. This type was examined only as part of the mallard evaluation. It is dominated by nonwoody plants, with grasses being the dominant herbaceous species. Common grasses in the study area include cheat grass (*Bromus tectorum*), crested wheatgrass (*Agropyron cristatum*), and bluebunch wheatgrass (*A. spicatum*).

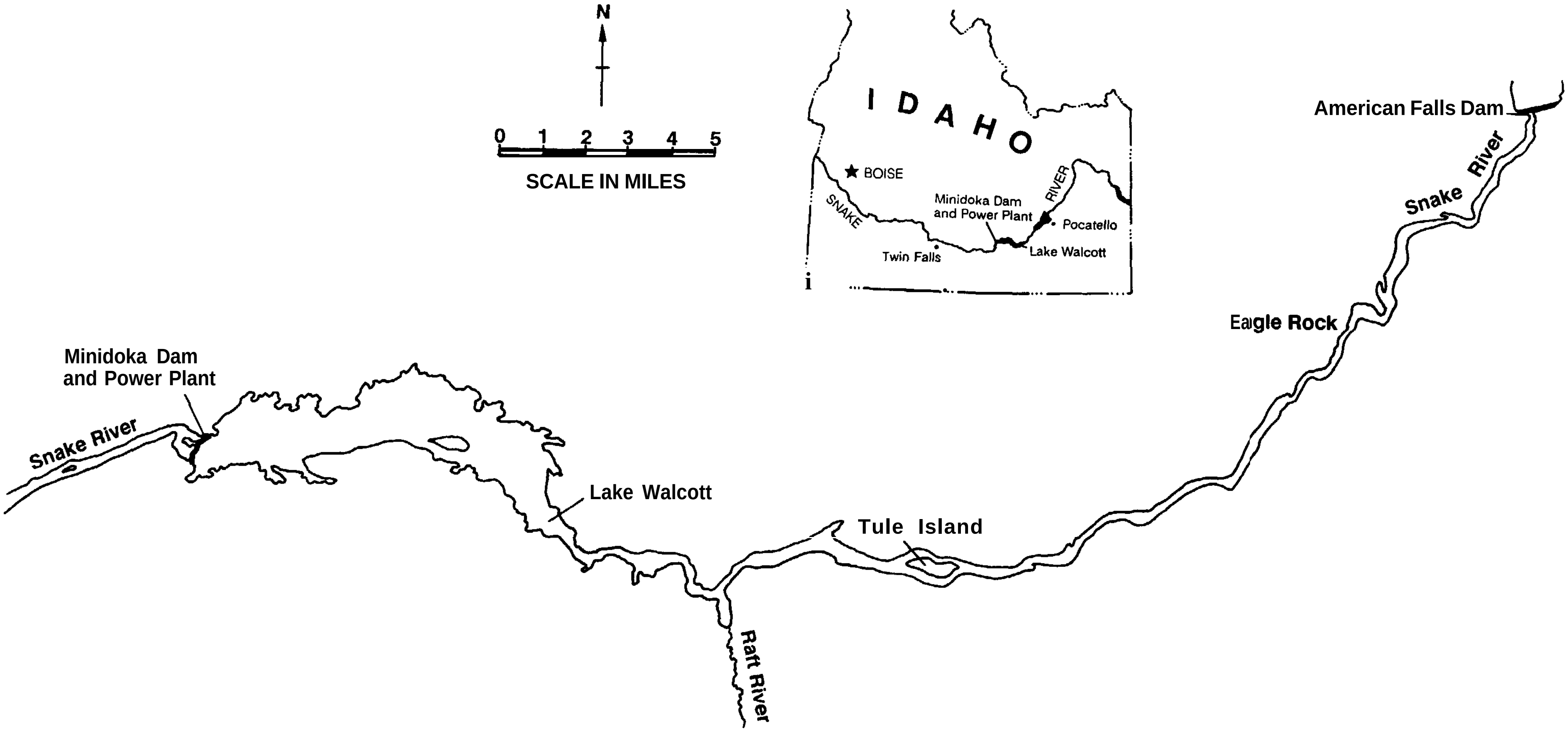


Fig. 1. Minidoka Dam and Reservoir.

Russian olive (deciduous shrubland). This type was examined only as part of the mallard evaluation. It occurs in narrow strips along portions of the reservoir shoreline. It is dominated by Russian olive (*Elaeagnus angustifolia*) generally less than 6 meters (20 feet) in height. The understory is comprised of a diversity of shorter shrubs, grasses, and forbs, most of which are upland species.

Juniper (evergreen shrubland). This type was examined only as part of the mallard evaluation. It is dominated by western juniper (*Juniperus scopulorum*) generally less than 6 meters (20 feet) in height.

Agriculture. In this report, this type refers to lands that are periodically plowed and planted to crops, or mowed for hay.

Mining area. This type refers to areas currently being mined, or areas that were mined and abandoned.

METHODS

The interagency team of biologists used the Habitat Evaluation Procedure (USFWS 1980b) to estimate hydroelectric impacts to wildlife in terms of Habitat Units. For a given species, one HU is equivalent to one acre of prime habitat. For each target species evaluated, the interagency team estimated the effects of the project on the species' habitat quality, measured with the Habitat Suitability Index (HSI). An HSI is a number between 0 and 1.0. It is a numerical index that represents the capacity of a given habitat to support a selected fish or wildlife species. Species models, comprised of measurable habitat variables, were used during HSI determination. Habitat Units for a given target species were calculated by multiplying its HSI times the acreage in the study area providing habitat for the species.

SELECTION OF TARGET SPECIES

The interagency work group chose target species to represent a broad spectrum of wildlife and habitats affected by the hydropower facility. The species were chosen because they are of high priority according to state or federal programs, and/or because they are indicator species used to describe habitat conditions for groups of species with similar habitat needs. The target species were evaluated in nine cover types that provided wildlife habitat (Table 1).

Target Species	Reason for Selection
Mallard	Indicator species for breeding dabbling ducks,
Redhead	Indicator species for migrating diving ducks.
Western grebe	Indicator colonial nesting waterbird.
Marsh wren	Indicator species for emergent wetlands.
Yellow warbler	Indicator species for scrub-shrub wetlands.
River otter	Indicator species for riverine habitat.
Mule deer	Indicator big game species.
Sage grouse	Indicator upland game species.

Table 1. Target species and cover types in which they were evaluated.

Target species	Emergent wetland	Scrub-shrub wetland	Forested wetland	Lacustrine	Riverine	Sagebrush-grassland	Grassland'	Russ oli
Mallard[2]	X	X	X	X	X	X	X	
Redhead				X	X			
Western grebe	X							
Marsh wren	X	X						
Yellow warbler		X						
River otter[3]					X			
Mule deer	X	X	X			X		
Sage grouse						X		

1 Cover type occurred only within nesting habitat portion of mallard evaluation area.

2 Evaluation area included upland nesting habitat to 100 meters from wetland edge.

3 Evaluation area included 20 meters of riparian habitat adjacent to river shorelines.

HABITAT QUANTITY

Post-construction cover type acreages were determined from USFWS National Wetland Inventory draft maps. Vegetation cover types were delineated by the USFWS on these 1:24,000 scale orthoquad maps using 1984 color infrared aerial photography. Accuracy of cover typing was ground-truthed by the HEP team during the fall of 1988. Only very minor adjustments in the USFWS delineations were needed. Cover type terminology in this report generally follows Cowardin et al. (1979) and USFWS (198Oc).

Pre-construction cover type acreages were estimated using measurements taken from 1905 USBR maps, which had been prepared principally to show placer mining locations. These detailed maps were drawn on a 1:3,600 scale and showed 2 or 5-foot contour intervals. The mapwork covered about 70% of the study area distance along the Snake River channel, and covered all of the Raft River area. On all 1905 maps, crews had delineated river channels, islands, placer mines, and contours. On 7 of 22 mapping units in the study area, crews had mapped areas of scrub-shrub wetlands identified as “dense willows,” emergent wetlands identified as “wild meadow,” and agriculture.

For the purpose of estimating wetland acreages, the pre-construction river and riparian area was divided into three areas: the Raft River area: the relatively constricted (narrow floodplain) portion of the Snake River from the upstream boundary of the study area (river mile 707.0) down to river mile 680.5; and the relatively broader (wider floodplain) portion of the Snake River downstream to the lower end of the spillway (river mile 674.7).

All of the Raft River area had been cover typed in 1905. Therefore, emergent and scrub-shrub wetland acreages could be measured directly on the maps.

Within the upstream Snake River portion, about 20% of the river distance was cover typed in 1905. Palustrine wetland acreages in the upstream portion were estimated by measuring emergent and scrub-shrub wetland acreages along cover typed river reaches and extrapolating their rates of occurrence (acres per mile) to unmapped areas.

Within the downstream Snake River portion, about 10% of the river shoreline was cover typed in 1905, and about 55% of the shoreline was contour mapped. Wetlands mapped in this portion occurred between the 1905 river shoreline and elevations 10 feet above the river level. Total wetland acreage was estimated by measuring the acreage between the river shoreline and the lo-foot contour line along contour mapped shorelines, and extrapolating that rate of occurrence (acres per mile) to unmapped areas. The proportions that emergent and scrub-shrub wetlands comprised of the total wetland acreage were estimated from their proportions measured along shorelines cover typed in 1905.

After estimating emergent and scrub-shrub wetland acreages in the pre-construction study area, acreages were determined for four other cover types. Agriculture and mining areas were measured directly on the 1905 maps, because the work group believed those cover types had been mapped completely. The riverine cover type was measured on the 1905 maps after missing river segments were drawn onto the maps: each segment that was not mapped in 1905 was assumed to be equal in width to the mapped segments that existed upstream and downstream. Sagebrush-grassland was the remaining cover type known to exist in the pre-construction study area (Kenagy 1914; Davis 1923, 1935). This cover type's acreage was calculated by subtracting the acreages of all other cover types from the total acreage in the study area.

HABITAT QUALITY

This study required the work group to examine the habitat value of 11 cover types for 8 target wildlife species. A total of 33 variables had to be estimated for pre-construction and post-construction (existing) conditions. Values of the 22 variables that ultimately were used in species HSI models are presented in Appendix C.

Post-construction habitat conditions were sampled on and around Minidoka Reservoir. These existing conditions include the effects of USBR and USFWS management within the Minidoka Dam and Reservoir study area. After three days of field tours and selection of sampling methods, the work group spent six days collecting field data in existing habitat. Generally, at each sample site, a 200-foot line transect was randomly selected, and vegetation measurements were taken along the transect. Due to time constraints and the fact that most wetland sample sites were small (<1 acre), the work group chose to ocularly estimate most wetland habitat variables at each sampling site. This made it possible, with limited time, to sample more wetland sites in order to characterize the study area.

Field data were collected at 14 sites in the sagebrush-grassland cover type, six in emergent wetlands, five in deciduous scrub-shrub wetlands, one in deciduous forested wetlands, three in grasslands, five in the Russian olive type, and one in the juniper type. Sample sizes generally reflected the relative occurrence of each cover type in the study area. The level of sampling was based on work group agreement, given time and budget constraints. Variables in the lacustrine and riverine cover types were either estimated by the work group or measured on maps or aerial photos.

Pre-construction habitat conditions were more challenging to estimate. After review of pre-construction photographs and other available information, the work group agreed that field data collected in existing sagebrush-grassland habitat adjacent to Minidoka Reservoir were representative of pre-construction conditions in terms of canopy coverage, shrub height, and vertical cover density. However, habitat conditions in other cover types adjacent to the reservoir were not considered representative of 1905 conditions. Therefore, pre-construction wetland variables were estimated by the work group, using field tour observations, post-construction data, early 1900's photographs, interviews with long-time residents, and available historical information. Mining and agricultural areas were assumed to provide zero habitat quality for the target species.

Mallard

A breeding mallard model (Appendix B) was used to evaluate habitat suitability. The model assumes that mallard habitat quality depends on breeding season food availability, nesting cover height and density, brood escape cover, or cover type interspersion.

The post-construction evaluation area included all palustrine wetlands, the lacustrine littoral zone out to a depth of 2 feet, 10% of the riverine acreage in the spillway area, and adjacent upland nesting habitat to 100 meters (109 yards) beyond the wetland edge. The work group assumed the littoral zone, out to a depth of 2 feet, provides mallard brood habitat. This is based on the feeding depths preferred by dabbling ducks, in conjunction with brood preferences for feeding close to shoreline escape cover. The riverine portion is included because the work group estimated that 10% of the pre-construction Snake River provided shallows usable by ducks, so the same percentage was assumed to be the usable habitat in the post-construction river. The work group assumed the 100 meters of adjacent uplands included the most important dabbling duck nesting habitat, as reported by Bellrose (1976).

For the same reasons, the pre-construction evaluation area included all palustrine wetlands, 10% of the Snake River acreage, and 100 meters of adjacent upland nesting habitat beyond wetlands along the river. Within the 100 meter zone, the following areas were omitted from pre- and post-construction evaluation areas: placer mining areas, farmland, lava cliffs, slopes >70%, and upland habitat with access to water blocked by cliffs or mines.

Analysis of variables in the mallard model clearly showed nesting cover to have the lowest suitability index in the mallard evaluation areas. Therefore, efforts were focused on estimating this life requisite value. The visual obstruction method of Robe1 et al. (1970) was used to estimate vertical cover density. Ten measurements were taken along each 200-foot transect in the upland cover types. Visual obstruction measurements were taken from a distance of 4 meters (13 feet) and a height of 1 meter.

Redhead

Minidoka Reservoir provides important migratory duck feeding habitat. Therefore, the work group agreed to use a redhead model (Howard and Kantrud 1983) to evaluate the study area's ability to maintain migratory diving ducks. The model was written to assess redhead winter habitat, which Minidoka Reservoir generally does not provide. However, the model recognizes that redhead habitat quality depends on the abundance of submerged plants, their relative occurrence within feeding depths, and the amount of human disturbance in feeding areas. These habitat factors are also important in characterizing migratory habitat quality.

The work group agreed that the post-construction evaluation area would be the area that could potentially provide redhead feeding habitat. This was considered to be the lake area between the mean high water line and the 20-foot depth boundary. This is the maximum photic depth estimated by J. Hill, Minidoka NWR Manager from 1967 to 1986. Occurrence of submerged plants within this area was measured on 1968 aerial photography. Water clarity has improved in Minidoka Reservoir since the 1960's, as a result of upstream pollution abatement. It is possible this has caused an increased submerged plant abundance, because submergents can be affected by changes in light penetration (Davis and Brinson 1980). J. Hill (pers. commun.) believes that submerged plant biomass has probably increased between 1968 and now, but that distribution has not changed much, if any. He believes submerged plant acreages mapped in 1968 should be increased by 10% to account for 1) submerged plants that existed at depths the 1968 aerial photography could not penetrate, and 2) any increase in distribution that may have occurred over the last 20 years. The work group assumed 100% canopy coverage within the acreage estimated to support submerged plant beds.

Acres of foraging habitat were quantified for existing conditions in each of three feeding depth classes: 0 to 1 meter, 1 to 2 meters, and 2 meters to the extent of existing submergents. Acreages within each depth class were calculated from USBR area-capacity tables for the reservoir. Existing human disturbance values were estimated separately within areas where boating is allowed and areas closed to boating. Human disturbance factors included boating, hunting, and other recreation: and the proportions of the migration season in which various types and amounts of disturbance occurred.

Pre-construction area of potential foraging habitat was estimated by the work group to be 10% of the Snake River channel. Within this area, we assumed 50% of the acreage supported submerged plants. The work group assumed that any submerged plants available during migration would have been in the 0 to 1 meter depth class. This was assumed because pre-construction spring flows were in excess of 15 feet (4.6 meters) above the fall Snake River elevation: submergents that grew during the spring-summer growing season would have been exposed or in shallow water during the fall waterfowl migration. A human disturbance value was estimated, based on knowledge of agricultural and mining activities in the study area.

Western Grebe

Breeding habitat quality was assessed using a published western grebe model (Short 1984). The model acknowledges that western grebes require populations of small fish, emergent wetlands of sufficient size associated with open water, water depths of at least 12 inches within emergent vegetation, and seclusion from motorboat activity. Once the above requirements are met, habitat quality within emergent wetlands is based on water level fluctuation, maximum wave height, and vegetation/open water interspersion.

The work group agreed that existing emergent wetlands provide all of the model's prerequisites for western grebe habitat. The remaining three habitat quality variables were estimated for emergent wetlands in the post-construction study area, following methodology in Short (1984).

The pre-construction study area was assumed not to have provided any western grebe breeding habitat. Although grebes nest along the present-day Snake River from American Falls to Weiser (Larrison et al. 1967, Burleigh 1972), prior to construction of upstream dams, uncontrolled spring floods would have caused extremely poor habitat conditions for nesting grebes (C. Trost, Idaho State Univ., pers. commun.).

Marsh Wren

Breeding habitat quality was assessed using a published model (Gutzwiller and Anderson 1987). The model is designed for habitat evaluation of emergent and scrub-shrub wetlands. It acknowledges that marsh wren habitat quality depends on the growth form of emergent hydrophytes, canopy cover of emergent herbaceous vegetation, water depth in wetlands, and canopy cover of woody vegetation.

For existing conditions, the work group estimated these variables in the field at emergent and scrub-shrub wetland sampling sites. Eleven sites were examined.

Existing habitat conditions were not considered to be representative of pre-construction conditions. The work group estimated pre-construction habitat quality using water level and grazing information, 1905 cover type maps, and an interview with a long-time resident.

Yellow Warbler

Breeding habitat quality was assessed using a published model (Schroeder 1982). The model acknowledges that habitat quality depends on shrub canopy coverage, shrub height, and hydrophytic shrub occurrence. The yellow warbler was chosen as a target species to represent deciduous scrub-shrub wetlands. Its evaluation was limited to that cover type.

Existing habitat conditions were examined at five sampling sites. These data were not considered to be representative of pre-construction conditions, so the work group estimated habitat variables for pre-construction conditions, based on 1905 USBR maps and other available historical information.

River Otter

The work group developed a model (Appendix B) after reviewing draft models prepared by Ament (1984) and USFWS (1984). Pre-construction habitat quality was assessed in the riverine area and in associated terrestrial habitat to a distance of 20 meters (22 yards) from the river (Larsen 1983, Woolington 1984). The work group assumed prey did not limit river otters in the study area. We also assumed that reproduction suitability is a function of potential den site availability and streamside cover. Streamside cover was defined as lava cliff boulder fields and woody vegetation. Percent cover was measured on 1905 maps that show lava cliffs and have willow cover delineated. Potential pre-construction den sites were estimated by the work group while considering historical conditions and existing conditions upstream and downstream from the reservoir.

Post-construction habitat quality was assessed in riverine habitat within the Minidoka spillway and in associated terrestrial habitat within 20 meters of the riverine area. Minidoka Reservoir was not assessed as otter habitat. The work group agreed the reservoir provides no habitat for otters. The reservoir is not known to support any otters (J. Hill and D. Poppleton, pers. commun.). The reservoir freezes over nearly every winter, and there is a five-foot drawdown that causes an exposed mudflat at the water's edge for about four months each'winter. However, the exact reasons why the reservoir is unsuitable for otters are unknown at this time.

Mule Deer

A mule deer model (Appendix B) was used to assess pre- and post-construction habitat quality in all terrestrial cover types in the study area. During the assessment, winter food value was considered the limiting factor for mule deer in the area. The model assumes that mule deer winter food value is dependent upon total shrub canopy cover, preferred shrub canopy cover, and herbaceous canopy cover.

Post-construction habitat data were collected at 14 sample sites in the sagebrush-grassland cover type, six sites in emergent wetlands, five sites in scrub-shrub wetlands, and one site in the forested wetland type. Pre-construction habitat values for wetlands were estimated by the work group, using historical information and data collected for existing conditions. Pre-construction sagebrush-grassland habitat conditions were assumed to be represented by existing habitat values.

Sage Grouse

A sage grouse model (Appendix B) was used to assess pre-construction winter habitat quality in the sagebrush-grassland cover type. The work group assumed that winter habitat quality is a function of average sagebrush canopy cover and average height of sagebrush above snow. Data collected at 14 sample sites in existing habitat were considered representative of pre-construction conditions. Sage grouse were not evaluated in the post-construction study area. No sage grouse are known to have been observed in the study area since 1969 (USFWS, Minidoka NWR records).

RESULTS AND DISCUSSION

HABITAT QUANTITY

A total of 12,414 acres was quantified by cover type in the study area for pre- and post-construction conditions (Table 2). The pre-construction study area contained mostly sagebrush-grasslands in the upland area inundated. It also supported a riparian corridor containing 33.6 miles of the Snake River, 2.6 miles of the Raft River, and an estimated 935 acres of palustrine wetlands. Many islands existed in the river channel. The Snake River was uncontrolled in the early 1900's, and flood flows were certainly greater than flows that occur now.

The present-day study area is primarily lacustrine, with an estimated 4,376 acres of submerged plant beds. The shoreline of Minidoka Reservoir supports 362 acres of palustrine wetlands. Several islands exist within the reservoir. The 150-acre spillway area below the dam contains a complex of wetlands, uplands, and islands that are valuable wildlife habitat (USFWS 1980a, Bodhurtha 1988).

Table 2. Minidoka Reservoir pre- and post-construction cover type acreages.[1]

	Emergent wetland	Deciduous scrub-shrub wetland	Deciduous forested wetland	Lacustrine	Riverine	Sagebrush-grassland	Agriculture	Mining Area	Total
Pre-construction	502	433	0	0	3,321	7,990	52	116	12,414
Post-construction	321	37	4	11,692	106	254	0	0	12,414
Net change	-181	-396	+4	+11,692	-3,215	-7,736	-52	-116	

[1] Study area for these acreages was from the lower end of Minidoka spillway upstream to the upper end of Minidoka Reservoir. Acreages are for cover types within the boundary of the reservoir and spillway high water lines, plus areas where wetlands have become established around the reservoir and spillway.

TARGET SPECIES IMPACTS, STATUS, AND MANAGEMENT GOALS

Mallard

Hydroelectric Facility Impacts. The mallard is a dabbling duck that depends on wetlands and adjacent uplands for successful nesting and brood production. Their diet consists primarily of aquatic plants; the presence of shallow-water feeding areas is critical (Johnsgard 1975). Nests are generally located on the ground in dense herbaceous vegetation, usually within 100 meters of water (Bellrose 1976). An important habitat-related factor that affects mallard populations is predator-caused nest failure (Bellrose 1976). In summary, mallard production is best in areas that have dense herbaceous vegetation close to water, and that are relatively safe from predators.

There were an estimated 174 breeding mallard HU's gained in the study area as a result of the facility (Table 3). Other dabbling ducks with similar habitat requirements, such as the northern pintail, American wigeon, and gadwall, are assumed to have been benefited within the study area.

The model used in this evaluation indicated that upland nesting habitat quality was the lowest of the mallard life requisites evaluated under pre- and post-construction conditions, The estimated gain in HU's occurred because mallard habitat acreage was increased by an estimated 868 acres in the study area. Although there were net losses of an estimated 893 acres of palustrine and riverine wetlands, there were net gains of 740 acres of shallow-water littoral habitat and 1,021 acres of upland nesting habitat adjacent to study area wetlands.

Table 3. Minidoka Dam and Reservoir impact on breeding mallards, and acreages of cover types in the mallard evaluation area.

	Emergent wetland	Deciduous scrub-shrub wetland	Deciduous forested wetland	Lacustrine littoral	Riverine	Sagebrush-grassland	Grassland	Russian olive	Juniper	Total acres	HSI	HU's
Pre-construction	502	433	0	0	332	2,393	0	0	0	3,660	0.20	732
Post-construction	321	38	4	740	11	3,265	88	17	44	4,528	0.20	906
Net change	-181	-395	+4	+740	-321	+872	+88	+17	+44	+868		+174

Status and Management Goals. Chronic loss of mallard nesting habitat in Canada, and subsequent large reductions in production, have contributed to record low mallard populations nationwide. Breeding mallard populations in the intensively surveyed area of the United States and Canada have decreased from 8.7 million in the 1970's to 5.5 million as of 1985 (USFWS-Canadian Wildlife Service (CWS) 1986). Likewise, blue-winged teal, canvasback, and northern pintail numbers have decreased nationwide. "Continuing habitat degradation and loss since the early 1960's have diminished the likelihood of these populations recovering to former abundance without innovative and intensive management on private and public lands, greater efforts to preserve existing habitat, and changes in land use and agricultural practices on private lands" (USFWS-CWS 1986). The midcontinent mallard and pintail populations are designated as an immediate international priority. The North American breeding population goal for mallards is 8.7 million ducks by the year 2000. The pintail population is currently at 2.9 million, while the goal is 6.3 million (USFWS-CWS 1986). Bag limits on both mallards and pintails were reduced during the 1988-89 hunting season.

Idaho's 1987-88 duck hunters bagged only 187,000 ducks, a record low number (Will 1988). This season marked the sixteenth year of a gradual decline in the duck harvest since 1971, when waterfowl hunters took nearly 700,000 ducks in Idaho (Will 1988). The number of mallards counted during the 1988 midwinter survey (90,000) was down 29.9% from 1987 and down 43.7% from the previous five-year average (Will 1988). As a result, there is an important need to increase Idaho's resident duck populations by protecting and improving remaining wetland habitats.

IDFG statewide management goals for ducks include: 1) increase Idaho's resident and wintering duck populations, and 2) increase waterfowl habitat in Idaho (Will et al. 1986).

USFWS goals at Minidoka National Wildlife Refuge include: 1) provide maintenance habitat for waterfowl with special emphasis on safe habitat for molting birds, and 2) provide necessary safe nesting and feeding habitat for production of waterfowl at desired levels (Peck 1989). The mallard production goal at the refuge is 400 birds; production estimates from 1982 to 1986 averaged 216 birds. Total waterfowl production goal at the refuge is 1,945 birds: total production estimates from 1982 to 1986 averaged 969 birds (USFWS, Minidoka NWR records).

Redhead

Hydroelectric Facility Impacts. The redhead is a diving duck that requires open water areas to meet its habitat needs. They do not require uplands to meet any of their life requisites. Redhead food in freshwater wetlands consists of submerged vegetation. Submerged plant beds in shallow water are preferred as feeding sites over beds in deeper water. Human disturbance is likely the main factor governing the distribution of wintering redheads (Howard and Kantrud 1983).

There were an estimated 4,475 migrating redhead HU's gained in the study area as a result of the Minidoka facility (Table 4). There are an estimated 4,376 acres of submerged plant beds in the study area now, compared to 166 acres estimated for pre-construction conditions.

Table 4. Minidoka Dam and Reservoir impact on migrating redheads.

	Acres	HSI	HU's
Pre-construction	332	0.72	239
Post-construction	6,735	0.70	4,714
Net impact	+6,403		+4,475

Status and Manapement Goals. The redhead is a North American waterfowl species with both economic and ecological importance. It is highly desired by hunters (Howard and Kantrud 1983). Redhead numbers declined drastically in the early 1960's, and it became illegal to kill them from 1960 to 1963 (Bellrose 1976). Strict bag limits were imposed after that and are still in place. Wintering redhead counts fluctuate annually with the overall trend being fairly stable in Idaho, while the Pacific Flyway trend is declining (Figure 2). Little is known about their habitat requirements in Idaho or their migrations.

The North American goal for the breeding redhead duck population is 760,000 ducks in the year 2000 (USFWS-CWS 1986). In 1988, the breeding redhead population was an estimated 846,000 birds. There is no specific Pacific Flyway goal for redheads at this time (USFWS, pers. commun.).

USFWS goals at Minidoka National Wildlife Refuge include: 1) provide maintenance habitat for waterfowl with special emphasis on safe habitat for molting birds, and 2) provide necessary safe nesting and feeding habitat for production of waterfowl at desired levels (Peck 1989). The redhead production goal at the refuge is 145 birds: production estimates from 1982 to 1986 averaged 76 birds (USFWS, Minidoka NWR records).

IDFG statewide waterfowl goals include: 1) increase Idaho's resident and wintering duck populations, 2) increase waterfowl habitat in Idaho, and 3) initiate or cooperate in a study to gather information on the ecology and migration of redheads wintering in Idaho (Will et al. 1986).

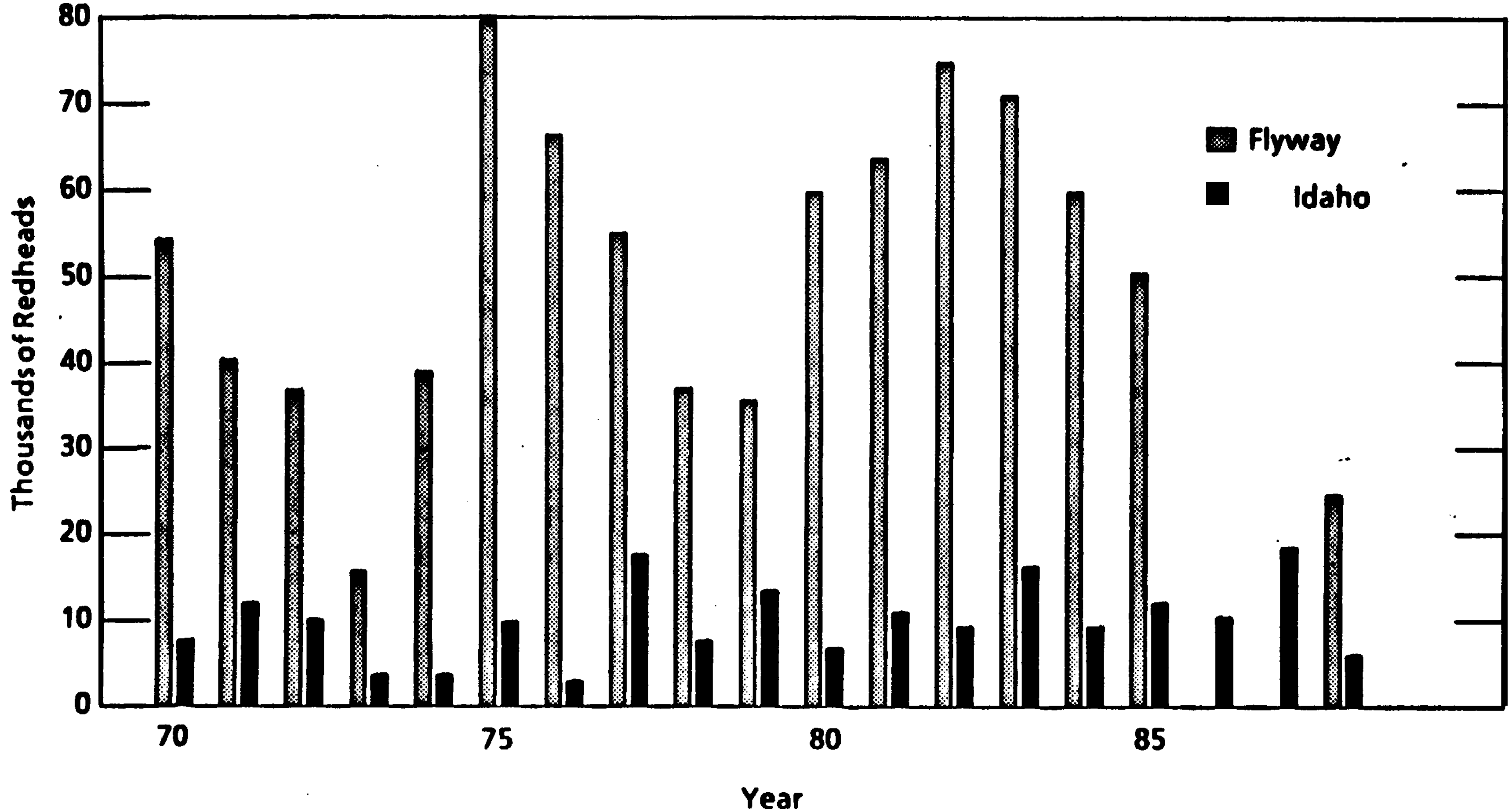


Fig. 2. Midwinter redhead counts in Idaho and Pacific Flyway.

Western Grebe

Hydroelectric Facility Impacts. The western grebe breeds in emergent wetlands of the midwestern plains and western mountain areas of North America. Its primary food is small fish. Western grebes generally build nesting platforms in persistent emergent vegetation at the edge of ponds or lakes. Stable water conditions and minimal wave action are critical components of nesting success (Short 1984).

The work group agreed that the pre-construction study area did not provide western grebe nesting habitat. Although emergent wetlands occurred along the Snake River, uncontrolled spring floods may have precluded successful grebe nesting (C. Trost, Idaho State Univ., pers. commun.).

The existing conditions in the emergent wetlands of Minidoka Reservoir are excellent for breeding grebes. Stable water during the nesting season allows grebes to nest inside bays and coves and in the lee of islands where wave action and motorboat disturbance are minimal. Following the western grebe model (Short 1984), a total of 273 HU's was estimated to have been gained in the study area's 321 acres of emergent wetlands (Table 5).

Table 5. Minidoka Dam and Reservoir impact on western grebes.

	Acres	HSI	HU's
Pre-construction			
Post-construction	321	0.85	273
Net impact	+321		t273

Status and Management Goals. The western grebe was recently split into two species: western grebe and Clark's grebe. Both are now known to occur at Minidoka Reservoir, but the two species have not been counted separately. Trost (1984) reported Minidoka Reservoir as a location of western grebe breeding colonies. Minidoka Reservoir supports about 3,000 western and Clark's grebes. There are two principal colonies plus scattered nesting by pairs in small emergent wetland patches throughout the reservoir (J. Hill, pers. commun.).

High priority goals of the USFWS at Minidoka National Wildlife Refuge are to provide safe nesting habitat for colonial nesting waterbirds, and to provide migration habitat and maintenance requirements for waterbirds (Peck 1989); IDFG goals pertaining to western grebes include: 1) consider changes in fishing regulations that would reduce disturbance on nesting colonies of some species during critical periods, 2) initiate seasonal closures on Department lands where necessary to protect colonial nesters, and 3) urge responsible parties to adopt water planning and flow regulation programs that minimize losses of waterbird nests (Morache et al. 1985).

Marsh Wren

Hydroelectric Facility Impacts. The marsh wren breeds in marshes throughout most of North America. Their food is primarily insects and spiders. Marsh wrens usually nest in cattails, bulrushes, or sedges in marshes >1 acre in size. Within marshes, standing water protects nests from predation and supports an important food source. Marsh wrens will nest in the emergent understory of scrub-shrub wetlands, but high tree or shrub densities lower the nesting value of a wetland (Gutzwiller and Anderson 1987).

The pre-construction study area was estimated to provide the following marsh wren habitat: 502 acres of emergent wetlands, and 433 acres of scrub-shrub wetlands. The pre-construction emergent wetland HSI for marsh wrens was low because evidence indicated this cover type was mostly comprised of sedge wet meadows that were moderately to heavily grazed by livestock. The scrub-shrub wetlands were very low quality marsh wren habitat due to high canopy coverage of woody vegetation, principally willows.

The present day relatively stable water levels have produced better habitat conditions for marsh wrens and other species with similar habitat needs. There were an estimated 207 marsh wren **HU's** gained in the study area (Table 6). The post-construction study area provides the following marsh wren habitat: 288 acres of high-quality emergent wetlands dominated by cattails and bulrushes, and 37 acres of low quality scrub-shrub wetlands dominated by willows.

Table 6. Minidoka Dam and Reservoir impact on marsh wrens.

	Emergent wetland		Scrub- shrub wetland		Total Study area		
	Acres	HSI	Acres	HSI	Acres	HSI	**HU's**
Pre-construction	502	0.10	433	0.01	935	0.06	56
Post-construction	288	0.89	37	0.17	325	0.81	263
Net impact					-610		**+207**

Status and Management Goals. It is assumed that marsh wrens currently nest within the study area in emergent and scrub-shrub wetlands >1 acre in size. They are considered to be common in the area during summer.

The marsh wren is closely tied to riparian habitat. Therefore, most management goals that pertain to riparian areas in Idaho affect marsh wrens and their emergent wetland habitat.

The IDFG will place special emphasis on the preservation and protection of riparian habitats. This will include: 1) fencing to exclude livestock, 2) supporting legislation to compensate private landowners who preserve riparian habitats, and 3) purchasing or acquiring easements to key riparian habitats. The Department will promote any reasonable efforts to rehabilitate damaged riparian habitats. It will further identify riparian zones used by any nongame species classified as Threatened, Endangered, Sensitive, or a Species of Special Concern and make every reasonable effort to preserve and enhance areas, whether through purchase, rehabilitation, fencing, or other means (Morache et al. 1985).

In response to past and continuing losses of wetlands, the USFWS has identified these areas as unique and scarce on a regional basis. The mitigation goal for these riparian wetlands, as defined in the USFWS's mitigation policy, is no net loss of in-kind habitat values. The protection and enhancement of riparian wetlands is also consistent with the goals of the Migratory Bird Treaty Act, the Emergency Wetland Protection Act of 1987, and Executive Order 11990 (Sather-Blair, USFWS, pers. commun.).

Yellow Warbler

Hydroelectric Facility Impacts. The yellow warbler breeds throughout most of the United States and is a common breeder in scrub-shrub habitat in Idaho. Preferred nesting habitats for this insectivorous warbler are generally wet areas with abundant shrubs or small trees (Schroeder 1982) . Areas of extensive forest with closed canopies are generally avoided (Hebard 1961), while areas of low deciduous growth are preferred (Morse 1973). Schroeder (1982) summarized breeding bird censuses across the United States to determine nesting habitat needs of the yellow warbler. About 67% of all censused areas dominated by deciduous shrubs were used, while 100% of all shrub wetlands received use. Wetland shrub habitats also had the highest average breeding densities of yellow warblers.

There were an estimated 342 yellow warbler HU's lost in the study area (Table 7). The principal cause of this impact was the net loss of an estimated 396 acres of deciduous scrub-shrub wetlands along the river corridor. The pre-construction study area supported an estimated 433 acres of these willow-dominated wetlands along 33.6 miles of the Snake River and 2.6 miles of the Raft River. Presently, the reservoir shoreline provides only 37 acres of scrub-shrub wetland yellow warbler habitat.

Table 7. Minidoka Dam and Reservoir impact on yellow warblers.

	Acres	HSI	HU's
Pre-construction	433	0.87	377
Post-construction	37	0.95	35
Net impact	-396		-342

Status and Management Goals. The yellow warbler is closely tied to riparian habitat. Therefore, most management goals that pertain to riparian areas in Idaho affect yellow warblers. The IDFG will place special emphasis on the preservation and protection of riparian habitats. This will include: 1) fencing to exclude livestock, 2) supporting legislation to compensate private landowners who preserve riparian hab'itats, and 3) purchasing or acquiring easements to key riparian habitats. The Department will promote any reasonable efforts to rehabilitate damaged riparian habitats. It will further identify riparian zones used by any nongame species classified as Threatened, Endangered, Sensitive, or a Species of Special Concern and make every reasonable effort to preserve and enhance areas, whether through purchase, rehabilitation, fencing, or other means (Morache et al. 1985).

In response to past and continuing losses of scrub-shrub wetlands, the USFWS has identified this cover type as unique and scarce on a regional basis. The mitigation goal for these riparian wetlands, as defined in the USFWS's mitigation policy, is no net loss of in-kind habitat values. The protection and enhancement of riparian wetlands is also consistent with the goals of the Migratory Bird Treaty Act, the Emergency Wetland Protection Act of 1987, and Executive Order 11990 (Sather-Blair, USFWS, pers. commun.).

River Otter

Hydroelectric Facility Impacts. River otters prefer secluded portions of aquatic habitats with vegetated shorelines (Liers 1951). Ice-free areas along streams or lakes are needed in the winter. Shallow, clear waters are preferred for foraging. Otters do not excavate their own dens, but rather use dens dug by other animals or natural shelters such as log jams and jumbles of loose rock (Toweill and Tabor 1982). Melquist and Hornocker (1983) found that otters preferred riverine habitats to lakes and reservoirs.

There were an estimated 2,993 river otter HU's lost in the study area (Table 8). The pre-construction study area supported an estimated 3,897 acres of otter habitat along 33.6 miles of the Snake River and 2.6 miles of the Raft River. The post-construction study area supports an estimated 125 acres of prime otter habitat in the Minidoka Dam spillway area. The net impacts resulted from loss of high quality riverine and riparian habitat.

Table 8. Minidoka Dam and Reservoir impact on river otters.

	Acres	HSI	HU's
Pre-construction	3,897	0.8	3,118
Post-construction	125	1.0	125
Net impact	-3,772		-2,993

Status and Management Goals. Presently, unknown numbers of river otters occur immediately upstream (CH2M Hill 1982) and downstream (Bodhurtha 1988, USFWS 1980a) of Minidoka Reservoir. No otters are known to reside in the reservoir area (J. Hill and D. Poppleton, pers. commun.).

Idaho Department of Fish and Game statewide goals for river otter include: 1) maintain river otter populations and distribution, 2) encourage nonconsumptive enjoyment of river otters, and 3) improve the data base on river otter populations (Toweill et al. 1985).

Mule Deer

Hydroelectric Facility Impacts. Mule deer are herbivores that use a variety of habitats and usually migrate between seasonal ranges. Winter range is a critical component of mule deer habitat, and spring and summer-fall ranges are also very important (Trent et al. 1985). Mule deer winter habitat in most of southern Idaho is low elevation sagebrush-grassland range. Winter diet is principally browse (leaves and twigs of shrubs and trees). The availability of adequate browse is often the limiting factor for mule deer populations over much of their range (Schneegas and Bumstead 1977). Early spring is an important time of year for mule deer, and late winter-spring range is a key component of year-round habitat. Quality and quantity of nutritious forage in the spring has a major effect on mule deer production and survival (Wallmo et al. 1977). Spring diet contains a high percentage of grasses (Hill 1956) as well as forbs and browse (Kufeld et al. 1973). Summer-fall ranges are important because this is where deer produce fat reserves that allow survival through winter (Trent et al. 1985). Forbs and new shrub growth comprise most of the diet during this period (Schneegas and Bumstead 1977).

There were an estimated 3,413 mule deer HU's lost in the study area (Table 9). The principal cause of the impact was loss of winter foraging habitat and late-winter green-up areas. The pre-construction study area was estimated to contain the following mule deer habitat: 7,990 acres of sagebrush-grassland, 502 acres of emergent wetlands, and 433 acres of scrub-shrub wetlands. The post construction study area contains 321 acres of emergent wetlands, 254 acres of sagebrush-grassland, 37 acres of scrub-shrub wetlands, and 4 acres of forested wetlands.

Status and Management Goals. Presently about 800 to 1000 mule deer winter in the vicinity of the reservoir (D. Poppleton, IDFG, pers. commun.). Idaho Department of Fish and Game habitat-related goals for mule deer include: 1) acquire and/or improve winter range, 2) work toward maintaining access to habitat, through purchase of fee titles or easements, and 3) purchase parcels within or adjacent to the boundaries of established wildlife management areas (Trent et al. 1985).

Table 9. Minidoka Dam and Reservoir impact on mule deer.

	Emergent wetland		Scrub-shrub wetland		Forested wetland		Sagebrush-grassland		Total	Overall	
	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	Acres	HSI	HU's
Pre-construction	502	0.25	433	0.89	0	-	7,990	0.40	8,925	0.41	3,659
Post-construction	321	0.34	37	0.94	4	0.28	254	0.40	616	0.40	246
Net impact									-8,309		-3,413

Sage Grouse

Hydroelectric Facility Impacts. Sage grouse of the Snake River Plain often migrate many miles from summer range to winter range (Dalke et al. 1963, Connelly et al. 1988). Once on winter range, sage grouse depend on sagebrush for food and cover (Patterson 1952:198, Eng and Schladweiler 1972, Beck 1975, Wallestad 1975).

The pre-construction study area provided an estimated 3,755 wintering sage grouse HU's (Table 10). The study area was a "natural wintering ground for sage grouse" (USFWS 1940), supporting an estimated 7,990 acres of sagebrush-grassland that provided food and cover for wintering birds.

The post-construction study area does not support any sage grouse. The last sage grouse observed in the study area by Minidoka NWR personnel was in 1969 (USFWS, Minidoka NWR records).

Table 10. Minidoka Dam and Reservoir impact on wintering sage grouse.

	Acres	HSI	HU's
Pre-construction	7,990	0.47	3,755
Post-construction	0		0
Net impact	-7,990		-3,755

Status and Management Goals. Presently, there is no sage grouse use of the study area. Sage grouse winter in sagebrush-grasslands regionally. However, extensive conversion of native habitat to irrigated agriculture has severely reduced sage grouse numbers in the Minidoka Project area. Range fires and conversion of sagebrush lands to crested wheatgrass have also adversely affected sage grouse. There is a continuing loss of sagebrush acreage in the Minidoka area: hence, there is a pressing need to protect remaining sagebrush and to re-establish sagebrush on some rangelands.

Idaho Department of Fish and Game's habitat-related goals for sage grouse include: 1) slow the rate of habitat loss, and 2) encourage land managers to protect and enhance habitats (Rybarczyk et al. 1985).

MITIGATION GOALS

Throughout the Columbia River Basin and the entire United States, wetland (Brinson et al. 1981) and sagebrush-grassland (Braun et al. 1977) habitats have suffered significant declines in quantity and quality. Consequently, there are international, national, state, regional, and/or local management plans and goals to protect and enhance remaining wetland and sagebrush-grassland habitats (see Target Species Status and Management Goals sections).

The interagency work group's assessment of impacts to target wildlife species showed a net loss of 5,374 HU's in the Minidoka Dam and Reservoir study area (Table 11). Estimated habitat losses include 181 acres of emergent wetlands, 396 acres of scrub-shrub wetlands, 3,215 acres of riverine habitat, and 7,736 acres of sagebrush-grassland. Wetland habitat losses in the study area have been partially offset by an improvement in emergent wetland habitat quality, and gain of a lacustrine area that supports an estimated 4,376 acres of submerged plant beds.

Table 11. Summary of Minidoka Dam and Reservoir impacts to target species in the study area.[1]

	Pre-construction			Post-construction			Net impact	
Target species	Acres	HSI	HU's	Acres	HSI	HU's	Acres	HU's
Mallard	3,660	0.20	732	4,528	0.20	906	t868	t174
Redhead	332	0.72	239	6,735	0.70	4,714	+6,403	+4,475
Western grebe	-	-		321	0.85	273	t321	t273
Marsh wren	935	0.06	56	325	0.81	263	-610	+207
Yellow warbler	433	0.87	377	37	0.95	35	-396	-342
River otter	3,097	0.80	3,118	125	1.0	125	-3,772.	-2,993
Mule deer	8,925	0.41	3,659	616	0.40	246	-8,309	-3,413
Sage grouse'	7,990	0.47	3,755	-	-	-	-7,990	-3,755
Total net impact (HU's)								-5,374

[1] Study area for these impacts was from the lower end of Minidoka spillway upstream to the upper end of Minidoka Reservoir. Impacts were assessed within the boundary of the reservoir and spillway high water lines, plus areas where wetlands have become established around the reservoir and spillway. The mallard evaluation area included a 100 meter band of upland nesting habitat adjacent to the edge of wetlands.

Although some aspects of Minidoka Dam and Reservoir have been positive, the overall impact has been negative, and these impacts have contributed to wildlife problems in the general area. As a result, the interagency work group agreed that a mitigation plan should be developed for Minidoka Dam and Reservoir. The goal of this plan is to compensate for the losses identified in the study area. At this time, the work group believes mitigation efforts should be focused on target species that were adversely affected in the Minidoka Reservoir study area. The work group further believes that mitigation priorities and specific mitigation proposals should be developed during mitigation planning.

Implementation of the mitigation plan would help alleviate some problems associated with impacts to important wildlife habitats. Current wildlife problems and needs in the general vicinity of the Minidoka Reservoir include the following:

1) There is a continuing loss of sagebrush-grasslands, which provide crucial winter range for sage grouse and big game and provide habitat for numerous nongame species. Hence, there are pressing needs to protect remaining sagebrush and to re-establish sagebrush and other shrubs on some rangelands. The forb and grass components of some areas need to be enhanced to improve rangeland quality for big game, sage grouse, and many other species.

2) As a result of past and continuing losses, wetlands are considered unique and scarce in the Pacific Northwest. There was a net loss of 573 acres of palustrine wetlands in the Minidoka Dam study area, principally the scrub-shrub (willow) wetland cover type. There is a serious need to protect and enhance wetlands for the multitude of species that depend on this scarce resource.

3) Free-flowing riverine habitat has been considerably reduced during this century. Remaining riverine habitat needs to be protected and enhanced for river otters and the numerous other species dependent on free-flowing rivers.

LITERATURE CITED

Ament, S. 1984. Habitat Suitability Index models: river otter. Unpubl. report for NR561, Colorado State Univ., Fort Collins.

Beck, T.D.I. 1975. Attributes of a wintering population of sage grouse, North Park, Colorado. M.S. Thesis. Colorado State Univ., Fort Collins. 49pp.

Bellrose, F.C. 1976. Ducks, Geese, and Swans of North America. Stackpole Books, Harrisburg, Pennsylvania. 543pp.

Boccard, B. 1980. Important fish and wildlife habitats in Idaho: an inventory. USFWS, Boise, Idaho. 160pp.

Bodhurtha, T.S. 1988. Fish and Wildlife Coordination Act report on the Minidoka Dam spillway rehabilitation, Minidoka Project, Idaho-Wyoming. USFWS, Boise, Idaho.

Braun, C.E., T. Britt, and R.O. Wallestad. 1977. Guidelines for maintenance of sage grouse habitats. Wildl. Soc. Bull. 5:99-106.

Brinson, M.M., B.L. Swift, R.C. Plantico, and J.S. Barclay. 1981. Riparian ecosystems: their ecology and status. USFWS. FWS/OBS-81/17. 155pp.

Burleigh, T.D., 1972. Birds of Idaho. The Caxton Printers, Ltd., Caldwell, Idaho. 467pp.

CH2M Hill. 1982. Eagle Rock hydroelectric project, application for license for major unconstructed project, FERC Project No. 2789. Vol. IV, Exhibit E. Raft River Rural Electric Cooperative, Inc., Malta, Idaho.

Connelly, J.W., H.W. Browers, and R.J. Gates. 1988. Seasonal movements of sage grouse in southeastern Idaho. J. Wildl. Manage. 52:116-122.

Cowardin, L.J., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. USFWS. FWS/OBS-79/31. 103pp.

Dalke, P.D., D.B. Pyrah, D.C. Stanton, J.E. Crawford, and E.F. Schlatterer. 1963. Ecology, productivity, and management of sage grouse in Idaho. J. Wildl. Manage. 27:811-841.

Davis, G.J., and M.M. Brinson. 1980. Responses of submersed vascular plant communities to environmental change. FWS/OBS-79/33. USFWS. 69pp.

Davis, W.B. 1923. On the avifauna of Minidoka County and adjacent territory. Murrelet 4:3-4.

______. 1935. An analysis of the bird population in the vicinity of Rupert, Idaho. Condor 37:233-238.

Eng, R.L., and P. Schladweiler. 1972. Sage grouse winter movements and habitat use in central Montana. J. Wildl. Manage. 36:141-146.

Findholt, S.L. 1984. Organochlorine residues, eggshell thickness, and reproductive success of snowy egrets nesting in Idaho. Condor 86:163-169.

______, and C.H. Trost. 1981. White pelicans nesting in Idaho. Murrelet 62:19-20.

Gutzwiller, K.J., and S.H. Anderson. 1987. Habitat suitability index models: marsh wren. FWS/OBS-82/10.139. National Ecology Center, USFWS, Fort Collins, Colorado. 12pp.

Hebard, F.V. 1961. Yellow warblers in conifers. Wilson Bull. 73(4) 394-395.

Hill, R. 1956. Forage, food habits, and range management of the mule deer. Pages 393-414 in W.P. Taylor, ed., The Deer of North America. Stackpole Co., Harrisburg, PA.

Howard, R.J., and H.A. Kantrud. 1983. Habitat suitability index models: redhead (wintering). FWS/OBS-82/10.53. National Ecology Center, USFWS, Fort Collins, Colorado. 14pp.

Idaho Department of Fish and Game. 1979-1983. Winter waterfowl and eagle surveys. Unpubl. data.

Johnsgard, P.A. 1975. Pages 221-233 in Waterfowl of North America. Indiana Univ. Press. Bloomington and London.

Kenagy, F. 1914. A change in fauna. Condor 16:120-123.

Kufeld, R.C., O.C. Wallmo, and C. Feddema. 1973. Foods of the Rocky Mountain mule deer. USDA For. Serv. Res. Pap. RM-111.

Larrison, E.J., J.L. Tucker, and M.T. Jollie. 1967. Guide to Idaho Birds. J. Id. Acad. Sciences, Moscow, Idaho. 220pp.

Larsen, D.N. 1983. Habitats, movements, and foods of river otters in coastal southeastern Alaska. M.S. Thesis, Univ. of Alaska, Fairbanks.

Leptich, D.J. 1987. Minidoka North Side Pumping Division Extension Project: baseline wildlife studies. Idaho Dep. Fish and Game, Jerome. 77pp.

Liers, E.E. 1951. Notes on the river otter (Lutra canadensis). J. Mammal 32:1-9.

Martin, R.C., and L.A. Mehrhoff. 1985. Wildlife mitigation status report: Minidoka Dam and Reservoir. Pages H1-H10 in R.C. Martin, ed., 1985. Status review of wildlife mitigation at 14 of 27 major hydroelectric projects in Idaho. U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife.

Melquist, W.E., and M.G. Hornocker. 1983. Ecology of river otters in west central Idaho. J. Wildl. Manage. Wildlife Monograph No. 83. 60pp.

Morache, M., C. Chaffin, J. Naderman, and W. Melquist. 1985. Nongame management plan 1986-1990. Idaho Dep. Fish and Game, Boise. 82pp.

Morse, D.H. 1973. The foraging of small populations of yellow warblers and American redstarts. Ecology 54(2):346-355.

Patterson, R.L. 1952. The sage grouse in Wyoming. Sage Books, Inc. Denver. 341pp.

Peck, C.S. 1989. Letter of Jan. 6, 1989 regarding Minidoka National Wildlife Refuge objectives. USFWS, Southeast Idaho Refuge Complex, Pocatello, Idaho.

Robel, R.J., J.N. Briggs, A.D. Dayton, and L.C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. J. Range Manage. 23:295-297.

Rybarczyk, W.B., J. Connelly, et al. 1985. Upland game management plan 1986-1990. Idaho Dep. Fish and Game, Boise. 37pp.

Schneegas, E.R., and R.S. Bumstead. 1977. Decline of western mule deer populations: probable cause, tentative solution. Proc. Annu. Conf. West. Assoc. State Game and Fish Comm. 57:218-237.

Short, H.L. 1984. Habitat suitability index models: western grebe. FWS/OBS-82/10.69. National Ecology Center, USFWS, Fort Collins, Colorado. 20pp.

Schroeder, R.L. 1982. Habitat suitability index models: yellow warbler. FWS/OBS-82110.27. National Ecology Center, USFWS, Fort Collins, Colorado. 8pp.

Toweill, D.E., N.F. Johnson, G. McNeill, and K. Kiler. 1985. Furbearer management plan 1986-1990. Idaho Dep. Fish and Game, Boise. 26pp.

Toweill, D.E., and J.E. Tabor. 1982. River otter. Pages 688-703 in Chapman, J.A., and G.A. Feldhamer, eds., 1982. Wild mammals of North America. John Hopkins Univ. Press, Baltimore. 1147pp.

Trent, T., W. Bodie, and C. Brown. 1985. Mule deer management plan 1986-1990. Idaho Dep. Fish and Game, Boise. 43pp.

Trost, C.H. 1985. Status and distribution of colonial nesting waterbirds in Idaho. Idaho Dep. Fish and Game, Boise, Idaho.

U.S. Bureau of Land Management. 1984. Monument resource management plan: draft environmental impact statement. Shoshone District, Shoshone. Idaho.

U.S. Bureau of Reclamation. 1949. Bureau of Reclamation project feasibilities and authorizations.

______. 1981a. Minidoka power plant rehabilitation and enlargement: draft feasibility report.

______. 1981b. Minidoka power plant rehabilitation and enlargement: draft environmental statement.

______. 1981c. Project data.

______. 1982. Minidoka power plant rehabilitation and enlargement: final environmental statement and feasibility report.

U.S. Fish and Wildlife Service. 1940. Quarterly narrative reports, Minidoka NWR.

______. 1980a. Coordination Act report: Minidoka power plant rehabilitation and enlargement. Principal investigator: James Nee.

______. 1980b. Habitat evaluation procedures. Ecological Services Manual 102. Division of Ecological Services, Washington, D.C.

______. 1980c. Habitat evaluation procedures. Ecological Services Manual 103. Division of Ecological Service, Washington, D.C.

______. 1984. Draft habitat suitability index model: river otter. Ecological Services Office, Sacramento, California.

______, and Canadian Wildlife Service. 1986. North American Waterfowl Management Plan. 33pp.

Wallestad, R.O. 1975. Life history and habitat requirements of sage grouse in central Montana. Montana Dep. Fish and Game Tech. Bull. 66pp.

Wallmo, O.C., L.H. Carpenter, W.L. Regelin, R.B. Gill, and D.L. Baker. 1977. Evaluation of deer habitat on a nutritional basis. J. Range Manage. 30:122-127.

Will, G.C., C.T. Kvale, and J.A. Hayden. 1986. Waterfowl, sandhill crane, and snipe management plan 1986-1990. Idaho Dep. Fish and Game. 37pp.

Will, G.C. 1988. Statewide surveys and inventory. Oct. 1, 1987 to March 31, 1988. Job progress report, Study II, Job 3. Waterfowl fall and winter surveys, harvest, and banding. Idaho Dep. Fish and Game. 25pp.

Woolington, J.D. 1984. Habitat use and movements of river otters at Kelp Bay, Baranof Island, Alaska. M.S. Thesis, Univ. of Alaska, Fairbanks.

APPENDIX A

ACRONYMS USED

BLM - Bureau of Land Management

BPA - Bonneville Power Administration

cfs - cubic feet per second

CI - Component Index

CWS - Canadian Wildlife Service

HEP - Habitat Evaluation Procedure

HSI - Habitat Suitability Index

HU - Habitat Unit

IDFG - Idaho Department of Fish and Game

NWR - National Wildlife Refuge

SI - Suitability Index

USBR - U.S. Bureau of Reclamation

USFWS - U.S. Fish and Wildlife Service

APPENDIX B

EVALUATION SPECIES MODELS

Mallard Model (Breeding)

Sather-Blair, USFWS, unpubl. model

Life Requisite Values

Food (Xl) - Related to the area of various wetland types within a sampling area that are shallow enough for a dabbling duck to feed (<60 centimeters water depth is optimum) during the breeding season. Model assumes that seasonally flooded wetlands (i.e. wet meadows, etc.) provide a better food source than permanently flooded wetlands.

Reproduction (X_2) - Related to the height and density of nesting cover (residual vegetation).

Cover (X3) - Related to the percent of shoreline dominated by emergent or scrub-shrub wetland vegetation. Shorelines with little or no vegetation provide marginal escape cover for broods. Only wetlands with open water available during the brooding season should be evaluated.

Interspersion (X4) - Related to the availability of several kinds of wetlands and upland areas capable of satisfying specific seasonal needs.

Habitat Evaluation Criteria

Food: Seasonal wetlands, which produce highest quantities of aquatic invertebrates (McKnight and Low 1969), are preferred feeding habitat for laying mallard hens (Dwyer et al. 1979; Krapu et al. 1983; Cowardin et al. 1983). Duebbert et al. (1983) found the density of mallard pairs/hectare to be higher in seasonal than semi-permanent wetlands.

Xl =

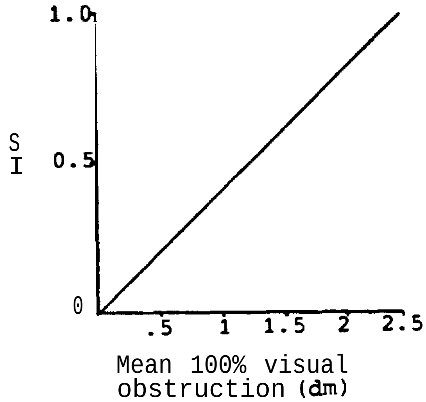
A - Temporarily flooded: surface water is present for brief periods during growing season. SI value = 0.3

B - Seasonally flooded: surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. SI value = 1.0

C - Semi-permanently flooded: surface water persists throughout the growing season during most years. SI value = 0.8

D - Permanent flooded: water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes (Cowardin et al. 1979). SI value = 0.5

Reproduction: Mallard nesting success is the highest in cover with the greatest height-density of residual vegetation (i.e. concealed from all directions) (Miller and Collins 1954; Wheeler and Harris 1970; Kirsch et al. 1978; Kolemoen et al. 1984; Cowardline et al. 1985). See Robe1 et al. (1970) for explanation of visual obstruction technique. Reproduction value (X2) is a function of the height and density of nesting cover (residual vegetation).



Cover: Mallard broods will utilize wetlands having sparse to dense emergent or scrub-shrub vegetation. Wetlands devoid of wetland vegetation or open water are usually avoided. Marshes with shorelines bare of emergent vegetation are used less (Berg 1956; Godin and Joyner 1981: Talent et al. 1982; Rumble and Flake 1983).

X3 = Percent of shoreline dominated by emergent and/or scrub-shrub wetland vegetation for brood rearing wetlands (≥ 2 acres in size with some open water during brooding season).

A - 50% to 100% of shoreline. SI value = 0.7 to 1.0

B - 15% to 50% of shoreline. SI value = 0.4 to 0.6

C - 0% to 15% of shoreline. SI value = 0.1 to 0.3

Interspersion: The mallard utilizes a variety of wetland types for various life functions. Optimal mallard habitat will contain a variety of wetland types and sizes within close proximity of each other and upland nesting habitat. The lack of several wetland types can be compensated for by large water bodies, diverse in physical composition and that contain both shallow and deep sections. Evaluate interspersion value primarily using the criteria listed below.

X_4 = The number of wetland types (i.e. emergent, scrub-shrub, wet meadow, open water) and upland nesting areas within sampling area (must be at least 640 acres in size). The sampling area with the highest interspersion index will be assigned an SI value of 1.0. All other areas will be assigned an SI value in relation to this index number.

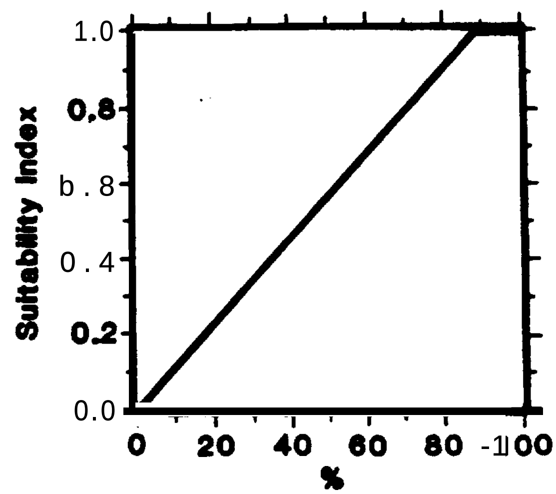
The Habitat Suitability Index is the lowest X_n value.

Redhead Model (Nonbreeding)

Adapted from Howard and Kantrud (1983)

Variables | Suitability Graph

V_1 = Percentage of study area supporting growth of aquatic plants.



V_2 = Percentage of total aquatic plants in each of three depth classes for calculated productive area.

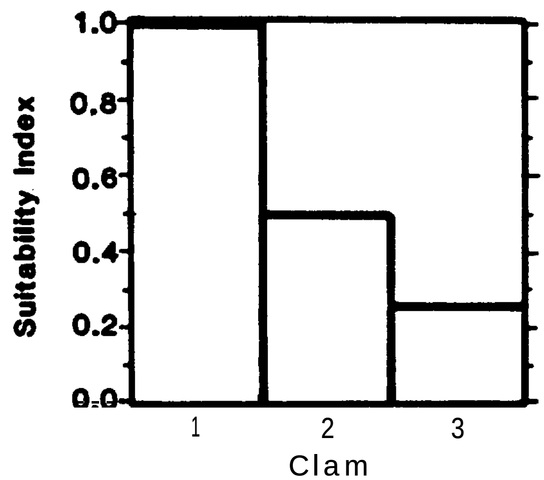
Class 1 - < 1 meter.

Class 2 - l-2 meters.

Class 3 - > 2 meters.

Note: The percentage in each class, expressed as a decimal, becomes the weighting factor (W) for that class. Calculate SI of V2 as follows:

$V_2 = 1.0W_1 + 0.5W_2 + 0.25W_3$



Variables

V_3 = Human disturbance to feeding area.

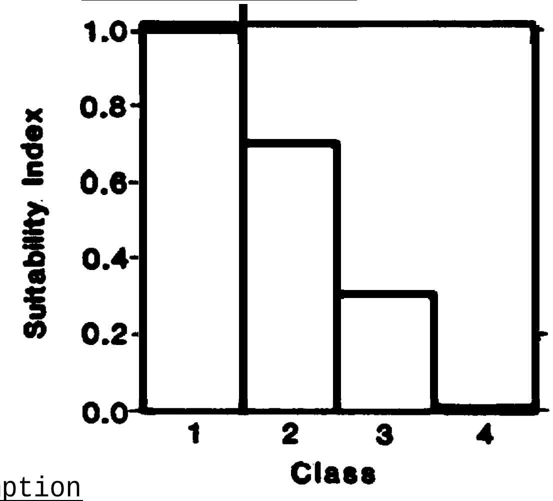
Class 1 - None to light.

Class 2 - Moderate.

Class 3 - Heavy.

Class 4 - Limiting.

Suitability Graph



Variable	Assumption
V_1	Aquatic plants are the major food of migrating redheads. As the amount of these species of submergent vegetation increases, the habitat suitability for migrating redheads increases.
V_2	Aquatic plant beds in shallow water are preferred as feeding sites over beds in deeper water.
V3	Human disturbance decreases suitability of habitat for migrating redheads. The level of disturbance has a greater effect on habitat suitability when the disturbance is applied to shallow water beds of aquatic plants than to deep beds.

Component Index (CI) Equation and HSI Determination

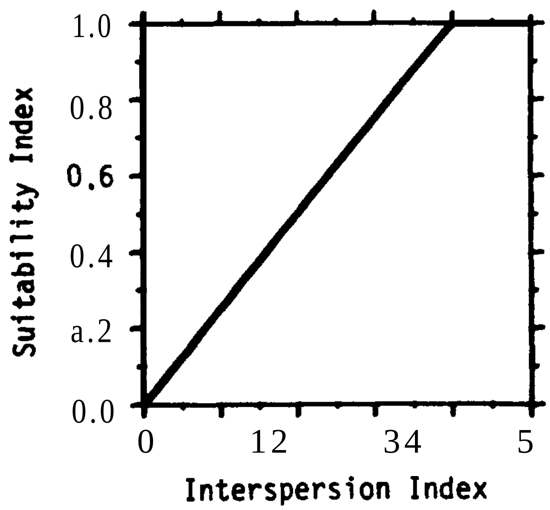
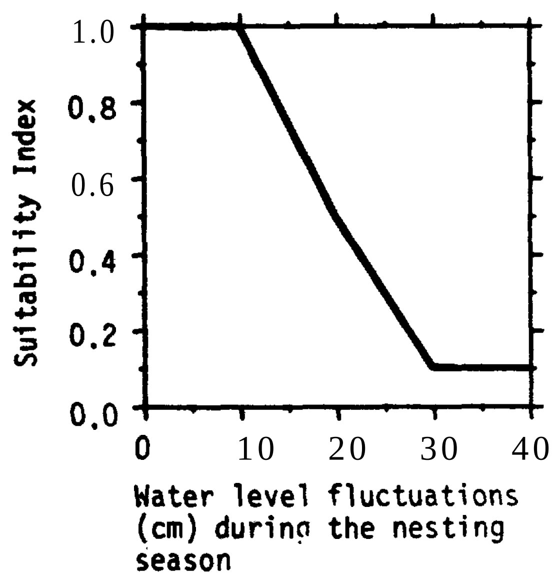
To obtain an HSI for redheads, the SI values for habitat variables must be combined into a Component Index (CI) for food. It is assumed that a compensatory relationship between V_1 and V2 describes food quality. This food quality is equally as important as the ability of the birds to exploit the resource, as measured by disturbance (V_3), in determining the food CI. The equation used to combine habitat variables is given below.

Food Component (CIF) = $[(SIV_1 \times SIV_2)^{1/2} \times SIV_3]^{1/2}$

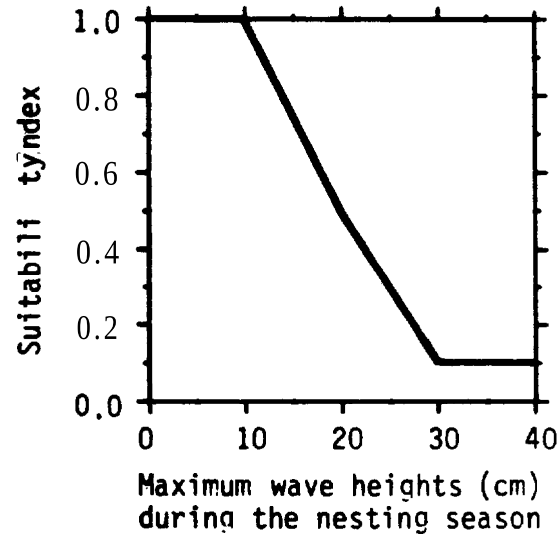
Western Grebe Model

Short (1984)

Cover type	Variable		Suitability index values
Lentic	V_1	Wetland within known or presumed breeding range of the western grebe is 20 ha (50 acres) or more in area.	SI = 1.0 if wetland is 20 ha or more in area = 0.0 if wetland is less than 20 ha in area
Herbaceous wetlands (HW) or lentic	V_2	Wetland has a population of fish about 27 to 88 mm (1 to 3½ inches) in length	SI = 1.0 if wetland possesses a population of fish of this size = 0.0 if fish of this size do not exist in the wetland
HW	V_3	Wetland possesses an area of emergent herbaceous vegetation that is no greater than 30% of the total wetland area.	SI = 1.0 if emergent herbaceous vegetation zone within the wetland is of this configuration = 0.0 if no zone of emergent herbaceous vegetation occurs within wetland or if such a zone is more than 30% of the wetland area
HW	V_4	Water levels around emergent herbaceous vegetation within the wetland are at least 30 cm (12 inches) deep and emergent herbaceous vegetation borders on open water.	SI = 1.0 if water levels are 30 cm or more in depth and if emergent vegetation zone borders on open water = 0.0 if water levels are less than 30 cm deep or if the emergent vegetation zone does not border on open water

HW	V_5	Motorboat activity during the April-July nesting season does not occur around sheltered bay or area of wetland containing emergent herbaceous vegetation.	SI = 1.0 if this condition is fulfilled = 0.0 if this condition is not fulfilled
HW	V_6	Quantity of edge between emergent herbaceous vegetation and open water within the emergent herbaceous vegetation zone.	
HW	V_7	Water level fluctuations within the emergent herbaceous vegetation zone during the April-July nesting season.	

Hw V_8 **Maximum wave heights within the emergent herbaceous vegetation zone during the April-July nesting season.**



<u>Equations</u>. Each model variable, 1 through 5, represents a dichotomous condition wherein a fulfilled condition receives an SI of 1.0 and an unfulfilled condition receives an SI of 0.0. SI values for Variables 1-5 are simply multiplied together. If the product is 0.0, then one or more conditions were unfulfilled and the suitability of the habitat is considered to be 0.0. If the product from multiplying Variables 1-5 together is 1.0, then the final estimate of Habitat Suitability equals the cube root of the product of Variables 6-8. This approach suggests that Variables 6-8 are equally important in developing a final estimate of the utility of herbaceous wetlands within a lake as reproductive habitat for the western grebe. The suggested equation is:

$$(V_1 \times V_2 \times V_3 \times V_4 \times V_5)\,(V_6 \times V_7 \times V_8)^{1/3}$$

Marsh Wren Model

Gutzwiller and Anderson (1987)

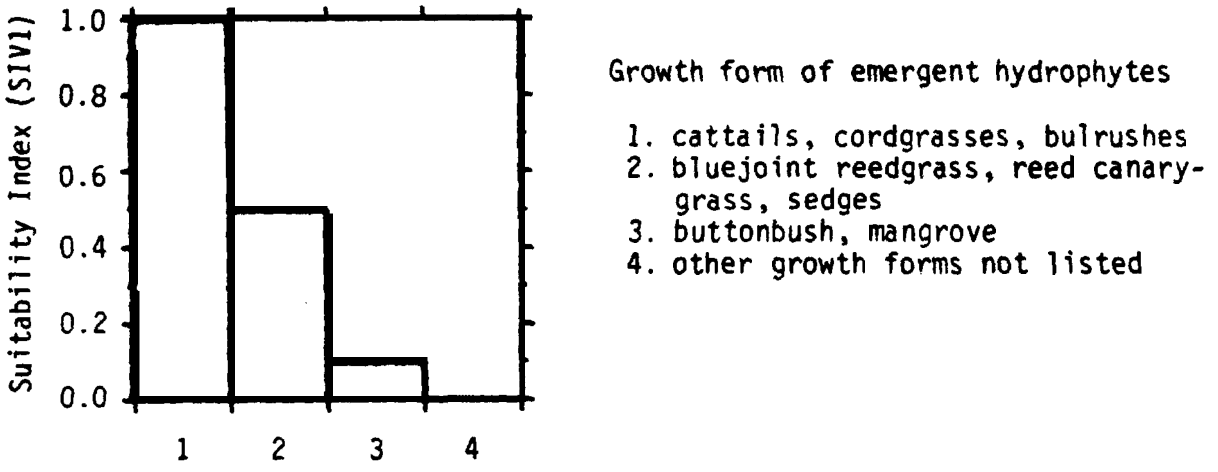


Figure 2. The assumed relationship between the growth form of emergent hydrophytes and the suitability of a wetland as cover/reproduction habitat for marsh wrens.

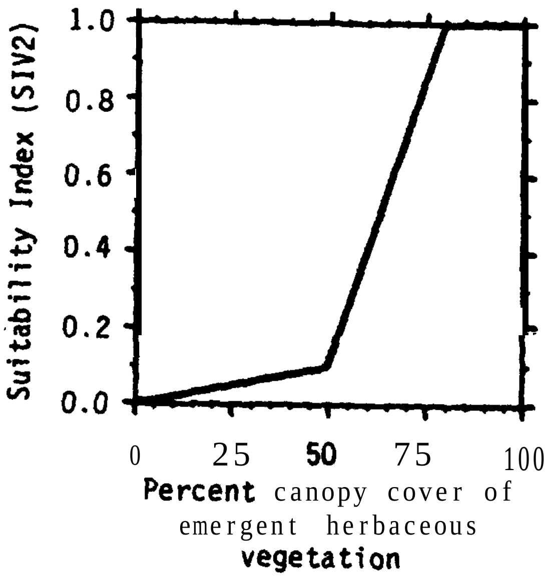


Figure 3. The assumed relationship between percent canopy cover of emergent herbaceous vegetation and cover/reproduction suitability of a wetland for marsh wrens.

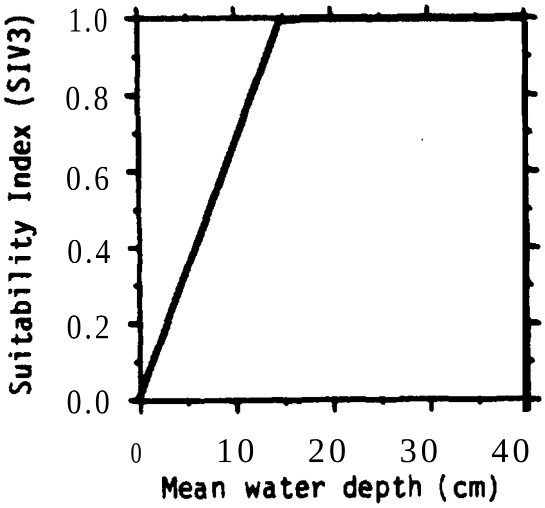


Figure 4. The assumed **relationship** between mean water depth and cover/ **reproduction** suitability of a wetland for marsh wrens.

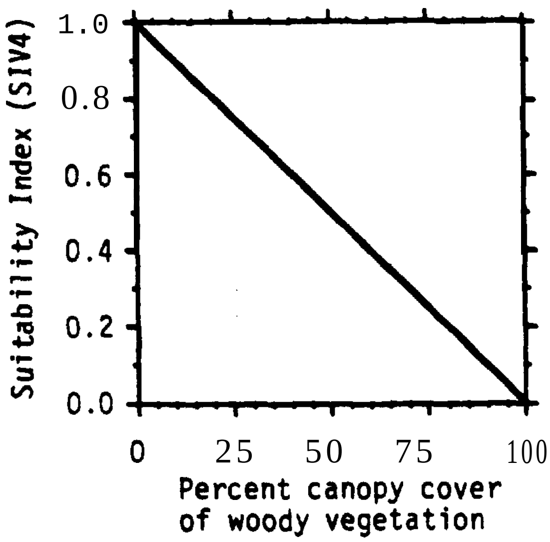


Figure 5. The assumed relationship between percent canopy cover of woody vegetation and cover/reproduction **suitability** of a wetland for marsh wrens.

HSI determination. We have assumed that habitat suitability, in terms of cover/reproduction for the marsh wren, is a reflection of the characteristics of individual permanently or semipermanently flooded estuarine, riverfne, lacustrine, or palustrine wetlands classed as emergent or scrub-shrub (Cowardin et al. 1979). Criteria characterizing the growth form of emergent vegetation (SIV1), the percent canopy cover of emergent herbaceous vegetation (SIV2), mean water depth (SIV3), and the percent canopy cover of woody vegetation (SIV4) can be used to assess suitability. Suftability among the first three variables is compensatory, i.e., a low value for one index can be compensated for by a high value in one of the other indices. A zero value for any of the three variables, however, indicates a wetland that is unsuitable in terms of cover/reproduction requirements for marsh wrens. The relationship between woody vegetation and habitat suitability is unclear, but we have assumed a negative affect on overall cover/reproduction suitability as the percent canopy cover of woody vegetation increases. Thus, SIV4 is used to lower the value of a wetland supporting woody vegetation. These relationships are described by equation 1.

$$HSI = (SIV1 \times SIV2 \times SIV3)^{1/3} \times SIV4 \quad (1)$$

Yellow Warbler Model

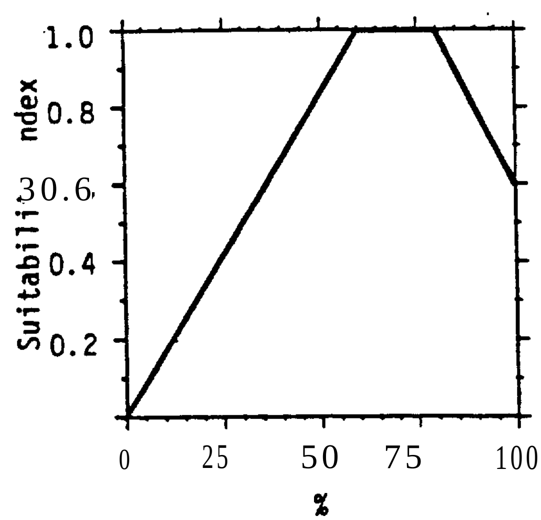
Schroeder (1982)

It fs assumed that optimal habitats contain 100% hydrophytic deciduous shrubs and that habitats with no hydrophytic shrubs will provide marginal suitability. Shrub densities between 60 and 80% crown cover are assumed to be optimal. As shrub densities approach zero cover, suitability also approaches zero. Totally closed shrub canopies are assumed to be of only moderate suit-abilfty, due to the probable restrictions on movement of the warblers in those conditions. Shrub heights of 2 m (6.6 ft) or greater are assumed to be optimal, and suitability will decrease as heights decrease to zero.

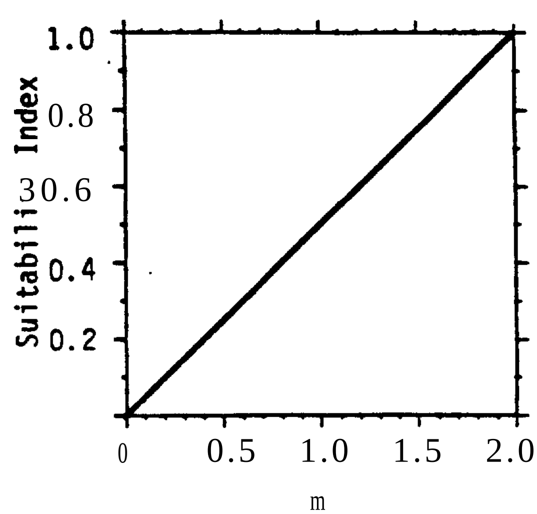
Each of these habitat variables exert a major influence in determining overall habitat quality for the yellow warbler. A habitat must contain optimal levels of all variables to have maximum suitability. Low values of any one variable may be partially offset by higher values of the remaining variables. Habitats with low values for two or more variables will provide low overall suitability levels.

Variable

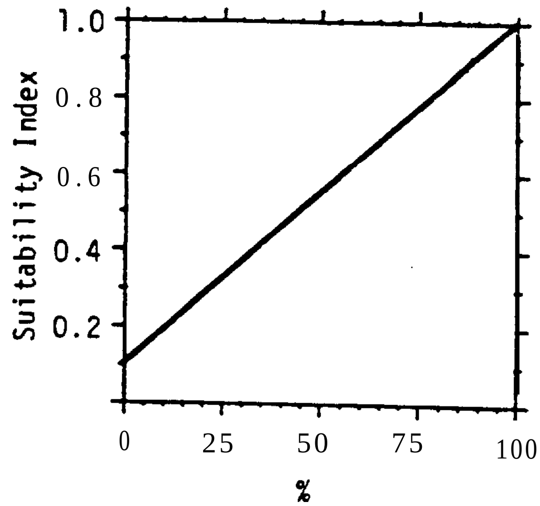
V_1 Percent deciduous shrub crown cover.



V_2 Average height of deciduous shrub canopy.



V_3 Percent of deciduous shrub canopy comprised of hydrophytic shrubs.



Life requisite	Cover type	
Reproduction	DSW	$(V_1 \times V_2 \times V_3)^{1/2}$

<u>HSI determination</u>. The HSI value for the yellow warbler is equal to the reproduction value.

River Otter Model

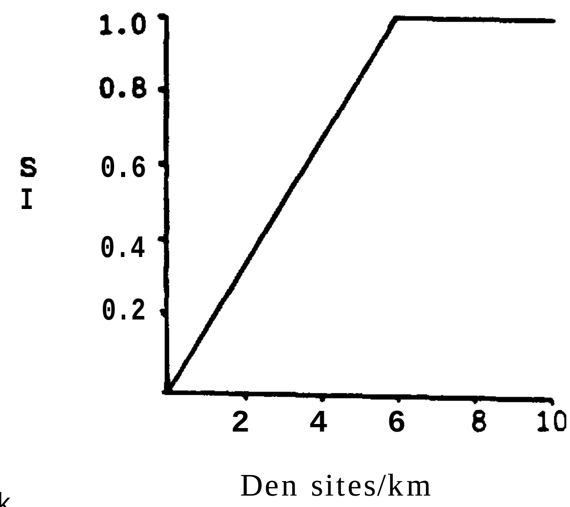
Adapted from Ament (1984) and USFWS (1984)

River otters require large amounts of cover, and long stretches of river devoid of vegetation may hinder otter movement (Bottoroff et al. 1976). Few otters are found in areas of sparse vegetation (Jenkens 1981). It is assumed that otters require a minimum of 252 vegetation and rock cover in riparian areas, habitat quality is optimal when cover exceeds 75X, and extremely dense cover (>90%) restricts movements.

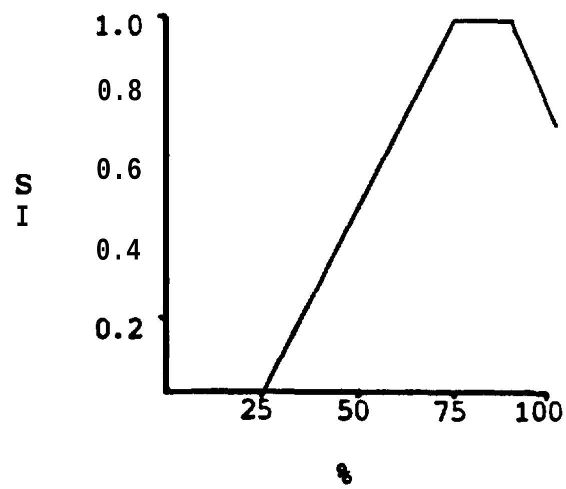
Otters do not excavate their own dens, but rather use dens dug by other animals or natural shelters such as log jams and jumbles of loose rock (Toweill and Tabor 1982). It is assumed that habitat quality is optimal when potential den sites exceed 6 per kilometer of river.

A reproduction component index was developed that assumes reproduction habitat quality depends on den site availability (V_1) and shoreline cover (V_2). The suggested model is (VI X V_2)$^{1/2}$.

V_1 = Number of potential den sites.



V_2 = Percent of vegetation and rock cover along shoreline.



Mule Deer Model

Browse often furnishes 75X or more of the mule deer's winter diet. The availability of adequate browse is often the limiting factor for mule deer populations over much of their range (Schneegas and Bumstead 1977). Forbs and grasses are supplemental winter foods and their availability will result in an increased food value for mule deer. Quantity and quality of nutritious forage in the spring has a major effect on mule deer production and survival (Wallmo et al. 1977).

Winter food value in all cover types is assumed to be a function of shrub canopy cover (V_1), preferred shrub canopy cover (V_2), and herbaceous canopy cover (V_3). V_1 and V2 are interactive variables and compensations exist between them. The abundance of shrubs and the availability of preferred shrubs are the most important components of the food value for winter range and have been weighted accordingly. The suggested function is:

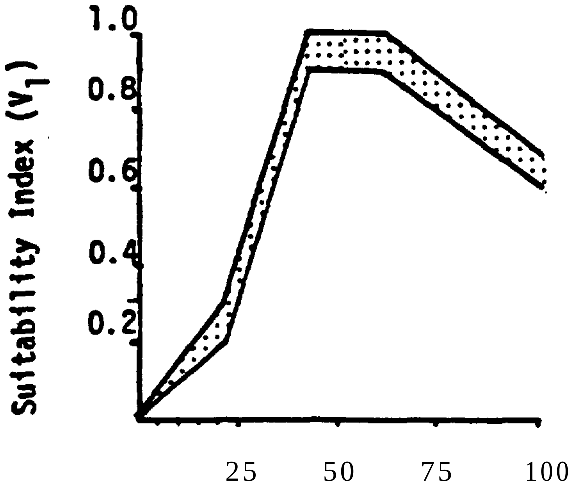
$$[3(V_1 \text{ x } V_2)^{1/2} \text{ t } V_3]/4^*$$

* When evaluating food on winter range the average snow conditions for the area must be taken into consideration. If the average depth of snow on the ground exceeds 24 inches for extended periods of time, the life requisite value should be adjusted downward. In determining winter snow conditions, consider snowfall records, slope, aspect, wind, and vegetation cover.

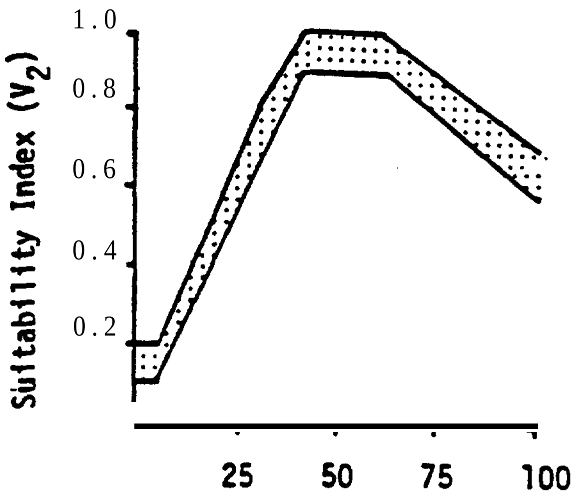
Variables

Suitability Index Curve

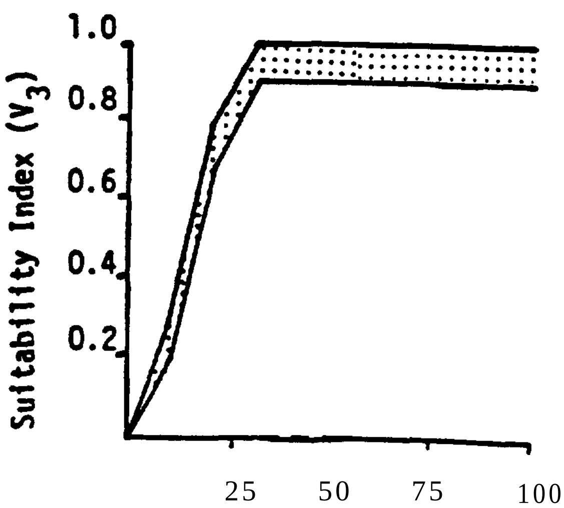
V_1 = Percent shrub crown cover 9.5 meters (5 feet) in height. (Do not consider small conifers as shrubs).



VP = Percent shrub crown cover of preferred shrubs cl.5 meters (5 feet) in height (preferred shrubs include, but are not limited to: antelope bitterbrush, mountain mahogany, ceanothus, chokecherry, serviceberry, and willow).



V_3 = Percent herbaceous canopy cover.

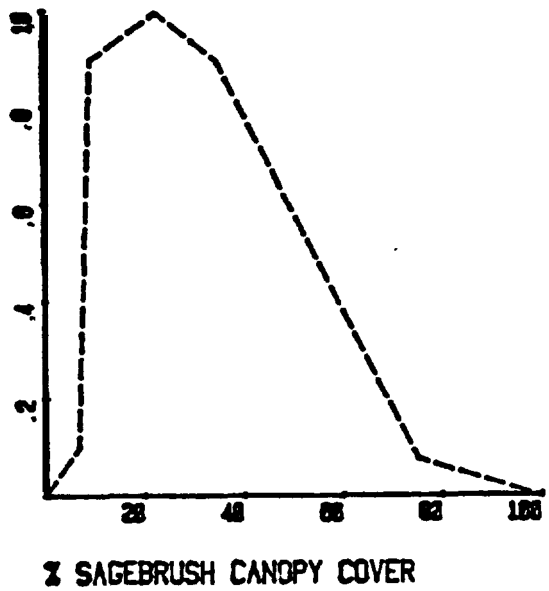


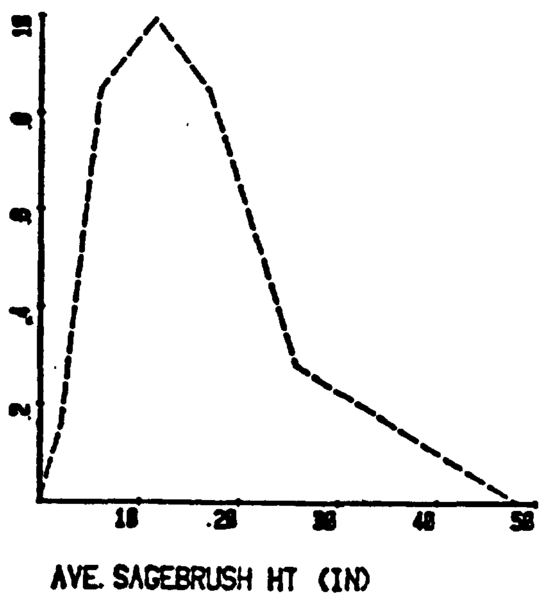
Sage Grouse Model (Wintering)

Adapted from **McCollough, USFWS,** unpubl. model

Sage grouse of the Snake River Plain often migrate many miles from summer range to winter range (Dalke et al. 1963, Connelly et al. 1988). Once on winter range, sage grouse depend on sagebrush for food and cover (Patterson **1952:198,** Eng and Schladweiler 1972, Beck 1975, Wallestad 1975).

A model was developed that assumes winter habitat quality depends on sagebrush canopy cover (V_1) and height of sagebrush above snow (V2). The suggested model is $(V_1 \times V_2)^{1/2}$.





APPENDIX C

VALUES OF VARIABLES USED IN EVALUATION SPECIES MODELS

Target species Cover type	Vertical herbaceous cover density (decimeters)		Percent of evaluation area supporting submerged plants		Percent of submerged plant area in 0-l meter depth class		Percent of submerged plant area in l-2 meter depth class		Percent of submerged plant area in >2 meter depth class		Human disturbance suitability index	
	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
Mallard												
Sagebrush-grassland	0.50	0.50										
Grassland		0.92										
Russian olive		>2.50										
Juniper		0.20										
Redhead												
Lacustrine			-	65		24		15		61		0.84
Riverine			50	-	100	-	0	-	0	-	0.70	-

Target species / Cover type	Water level fluctuation (cm) pre	Water level fluctuation (cm) post	Maximum wave height pre	Maximum wave height post	Interspersion suitability index pre	Interspersion suitability index post	Growth form of emergent hydrophytes pre	Growth form of emergent hydrophytes post	Mean water depth in wetlands (cm) pre	Mean water depth in wetlands (cm) post	Percent emergent herbaceous canopy cover pre	Percent emergent herbaceous canopy cover post	Percent deciduous shrub canopy cover pre	Percent deciduous shrub canopy cover post	Percent deciduous shrub canopy cover comprised of hydrophytes pre	Percent deciduous shrub canopy cover comprised of hydrophytes post	Mean deciduous shrub height (meters) pre	Mean deciduous shrub height (meters) post
Western grebe																		
Emergent wetland	-	<10	-	<10	-	2.42												
Marsh wren[1]																		
Emergent wetland								95% form no. 1, 5% form no. 2		>15		91		10				
Scrub-shrub wetland								64% form no. 1, 36% form no. 2		>15		41		57				
Yellow warbler																		
Scrub-shrub wetland													90	57	95	95	>2	>2

[1] The work group estimated a pre-construction HSI for each cover type, because there was insufficient information to estimate individual habitat variables.

Target species Cover type	Potential den sites/km		Percent vegetation and rock cover along shoreline		Percent shrub canopy cover <5 feet		Percent preferred shrub canopy cover <5 feet		Percent herbaceous canopy cover		Percent sagebrush canopy cover		Mean sagebrush height (inches)	
	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
River otter														
Riverine, riparian	>6	>6	57	>75										
Mule deer														
Emergent wetland					0	5	0	0	>50	>50				
Scrub-shrub wetland					80	39	80	39	>50	>50				
Forested wetland						5	-	5	-	20				
Sagebrush-grassland					13	13	0	0	>50	>50				
Sage grouse														
Sagebrush-grassland											11	11	33	33

APPENDIX D

VERTEBRATE WILDLIFE SPECIES IN PROJECT AREA

Season of Occurrence	Relative Abundance
SP - March-May	a - abundant
su - June-August	c - common
Fa - September-November	u - uncommon
Wi - December-February	0 - occasional
	r - rare

BIRDS (Minidoka NWR list)

	Sp	Su	Fa	Wi
Common loon	u	r	u	
Horned grebe	u	0	u	
Eared grebe	c	c	a	0
Western grebe	c	a	c	0
Pied-billed grebe	u	c	u	0
American white pelican	c	c	u	
Double-crested cormorant	c	a	c	0
Great blue heron	c	a	c	u
Great egret		r		
Snowy egret	u	c	u	
Cattle egret	0	0	0	
Black-crowned night-heron	c	c	u	
Green-backed heron	r	r		
American bittern	0	0	0	
White-faced ibis	u	u	u	
Tundra swan	c	r	c	u
Trumpeter swan			r	
Canada goose	c	c	a	c
Greater white-fronted goose	0		0	
Snow goose	U		u	0
Mallard	a	c	a	c
Gadwall	c	a	c	u
Northern pintail	a	c	a	u
Green-winged teal	c	u	c	u
Blue-winged teal	0	u	u	
Cinnamon teal	0	u	u	
Eurasian wigeon	r			
American wigeon	c	c	a	u
Northern shoveler	u	0	c	0
Wood duck	0		0	
Redhead	c	a	a	
Ring-necked duck	c	u	c	
Canvasback	c	u	a	
Greater scaup	0		0	
Lesser scaup	c	c	a	
Common goldeneye	c	0	c	c
Barrow's goldeneye	0	u		
Bufflehead	c	c	c	u
White-winged scoter				r
Ruddy duck	c	c	a	0

	Sp	Su	Fa	Wi
Hooded merganser	U		0	u
Common merganser	c	c	c	c
Red-breasted merganser	u	0	u	u
Turkey vulture	u	c	u	
Sharp-shinned hawk	c	c	c	u
Cooper's hawk	u	u	u	0
Red-tailed hawk	u	0	u	0
Swainson's hawk	u	c	c	
Rough-legged hawk	u	u	u	c
Ferruginous hawk	0	0		
Golden eagle	c	u	u	c
Bald eagle	c	0	u	c
Northern harrier	c	c	c	u
Osprey	0	0	0	
Prairie falcon		0	0	
Peregrine falcon	r	r	0	r
American kestrel	u	c	c	0
Sage grouse	0	0	0	0
California quail	0	0	0	0
Ring-necked pheasant	c	c	c	c
Gray partridge	u	c	c	u
Sandhill crane	r		r	
Virginia rail	r			
Sora	0	u	0	
American coot	c	c	a	0
Snowy plover	r			
Killdeer	c	c	a	0
Black-bellied plover	0	0		
Common snipe	u	c	u	0
Long-billed curlew	u	c	0	
Spotted sandpiper	u	0	r	
Willet	c	c	u	
Greater yellowlegs	u	c	u	
Lesser yellowlegs	0	0		
Red knot	r			
Pectoral sandpiper	0	0		
Baird's sandpiper		r		
Least sandpiper	0	u	u	
Long-billed dowitcher	u	u	0	
Western sandpiper	0	0	0	

	Sp	Su	Fa	Wi
Marbled godwit	u	u	0	
American avocet	u	c	0	
Black-necked stilt	0	u	r	
Wilson's phalarope	u	c	u	
Red-necked phalarope	0	0	r	
California gull	c	c	c	u
Ring-billed gull	c	c	c	u
Franklin's gull	c	a	u	
Bonaparte's gull	r		r	
Forster's tern	c	c	0	
Common tern	0	0	0	
Caspian tern	u	u	0	
Black tern	0	c	u	
Rock dove	0	0		
Mourning dove	u	c	c	
Common barn-owl	r	r		
Great horned owl	u	u	u	u
Burrowing owl	0	u	u	
Long-eared owl	0		a	0
Short-eared owl	u	u	u	u
Northern saw-whet owl		r		
Common nighthawk	c	c	0	
Rufous hummingbird	0	0		
Belted kingfisher	0	u	u	0
Northern flicker	c	c	c	c
Lewis' woodpecker	0		0	
Red-naped sapsucker	U		0	
Hairy woodpecker	r			
Downy woodpecker	U		0	u
Eastern kingbird	c	c		
Western kingbird	c	c		
Ash-throated flycatcher	0	0		
Say's phoebe	0			
Willow flycatcher	0	u		
Western flycatcher	0	0		
Western wood-pewee	u	u		
Horned lark	c	c	c	c
Violet-green swa low	u	c	0	
Tree swallow	u	u	u	
Bank swallow	c	a	c	
Northern rough-w nged swallow	u	u	o	
Barn swallow	c	a	c	
Cliff swallow	c	a	u	
Purple martin	r			
Steller's jay	0			
Black-billed magpie	a	a	a	c
Common raven	0	0	0	0
American crow	0	0	0	0
Black-capped chickadee	r		r	
Mountain chickadee	0		0	0
White-breasted nuthatch	0	r		0
Red-breasted nuthatch	0	r	0	0

	Sp	Su	Fa	Wi
Brown creeper	0		0	u
House wren	0	0		
Marsh wren	u	c	c	0
Canyon wren	0	0		
Rock wren	0	u	0	
Northern mock ngbird	r			
Gray catbird		r		
Sage thrasher	0	u	u	r
American robin	c	c	u	0
Varied thrush	0			0
Hermit thrush	0			
Swainson's thrush	0		0	
Veery	0			
Western bluebird	0	0	0	r
Mountain bluebird	0		0	
Townsend's solitaire				0
Golden-crowned kinglet	0		0	0
Ruby-crowned kinglet	U		u	0
Water pipit	0		0	
Bohemian waxwing	r			0
Cedar waxwing	u	0	0	
Northern shrike	0		0	u
Loggerhead shrike	u	0	u	0
European starling	c	c	a	u
Red-eyed vireo	0	r		
Warbling vireo	0	0	0	
Black-and-white warbler	r		r	
Orange-crowned warbler	0			
Nashville warbler	r			
Yellow warbler	u	u		
Yellow-rumped warbler	c	0	u	
Townsend's warbler			0	
MacGillivray's warbler	0	r	0	
Common yellowthroat	u	u	u	
Yellow-breasted chat	0	0		
Wilson's warbler	u	u	0	
American redstart	r		r	
House sparrow	c	c	c	c
Bobolink	0			
Western meadowlark	c	c	c	u
Yellow-headed blackbird	c	c	u	
Red-winged blackbird	c	c	c	0
Northern oriole	c	c	0	
Brewer's blackbird	c	c	u	0
Brown-headed cowbird	u	u		
Western tanager	c	u	0	
Black-headed grosbeak	0	0		
Lazuli bunting	u	0		
Evening grosbeak	0	0		0
Purple finch	0			
Cassin's finch	0			
House finch	u	0	u	0

	Sp	Su	Fa	Wi		Sp	Su	Fa	Wi
Common redpoll	0		0	u	Dark-eyed junco	C		u	c
Pine siskin	0		0	0	American tree sparrow				0
American goldfinch	c	u	u	0	Chipping sparrow	0	0	0	
Lesser goldfinch	r	r			Brewer's sparrow	u	u	0	
Rufous-sided towhee	r		r		Harris' sparrow				r
Lark bunting	0	0			White-crowned sparrow	c	u	u	u
Savannah sparrow	0	0	0		Fox sparrow			r	
Vesper sparrow	u	0	0		Song sparrow	c	c	c	c
Lark sparrow	u	0	0		Snow bunting				0
Sage sparrow	0	0							

MAMMALS (Minidoka NWR list, CH2M Hill 1982, Leptich 1987)

Masked shrew	Sorex cinereus
Vagrant shrew	Sorex vagrans
Little brown myotis	Myotis lucifugus
Nutall's cottontail	Sylvilagus nuttallii
Black-tailed jackrabbit	Lepus californicus
White-tailed jackrabbit	Lepus townsendii
Muskrat	Ondatra zibethicus
Yellow-bellied marmot	Marmota flaviventris
Golden-mantled ground squirrel	Spermophilus lateralis
Least chipmunk	Eutamias minimus
Yellow-bellied marmot	Marmota flaviventris
Townsends ground squirrel	Spermophilus townsendii
Uinta ground squirrel	Spermophilus armatus
Wyoming ground squirrel	Spermophilus elegans
Northern pocket gopher	Thomomys talpoides
Ord's kangaroo rat	Dipodomys ordii
Great Basin pocket mouse	Perognathus parvus
Western harvest mouse	Reithrodontomys megalotis
Deer mouse	Peromyscus maniculatus
Northern grasshopper mouse	Onychomys leucogaster
Montane vole	Microtus montanus
House mouse	Mus musculatus
Sagebrush vole	Lemmiscus curtatus
Beaver	Castor canadensis
Raccoon	Procyon lotor
Ermine	Mustela erminea
Porcupine	Erethizon dorsatum
Bobcat	Felis rufus
Striped skunk	Mephitis mephitis
Badger	Taxidea taxus
Red fox	Vulpes vulpes
Coyote	Canis latrans
Mink	Mustela vison
River otter	Lutra canadensis
Pronghorn	Antilocapra americana
Mule deer	Odocoileus hemionus
Elk	Cervus elaphus

AMPHIBIANS and REPTILES

Western whiptail	Cnemidophorus tigris
Common garter snake	Thamnophis sirtalis
Western terrestrial garter snake	Thamnophis elegans
Western rattlesnake	Crotalus viridus
Gopher snake	Pituophis melanoleucus
Racer	Coluber constrictor
Striped whipsnake	Masticophis taeniatus
Rubber boa	Charina bottae
Western skink	Eumeces skiltonianus
Desert horned lizard	Phyrnosoma platyrhinos
Short-horned lizard	Phrynosoma douglassii
Western fence lizard	Sceloporus occidentalis
Sagebrush lizard	Sceloporus graciosus
Longnose leopard lizard	Gambelia wislizenii
Long-toed salamander	Ambystoma macrodactylum
Striped chorus frog	Pseudacris triseriata
Pacific treefrog	Hyla regilla
Great Basin spadefoot	Scaphiopus intermontanus
Northern leopard frog	Rana pipiens

APPENDIX E

AGENCIES AND TRIBES LETTERS OF COMMENT

IDAHO **FISH &** GAME
600 South Walnut / Box 25
Boise, Idaho 83707

March 31, 1989

John Palensky, Director
Division of Fish and Wildlife, PJS
Bonneville Power Administration
P.O. Box 3621
Portland, OR 97208

Dear Mr. Palensky:

Enclosed is the Minidoka Dam Wildlife Impact Assessment. The report was funded by the Bonneville Power Administration pursuant to Section 1003(b)(2) of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program. The report was prepared by the Idaho Department of Fish and Game in consultation and coordination with the U.S. Bureau of Reclamation, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, Shoshone-Bannock Tribes, Northwest Power Planning Council, Bonneville Power Administration, and Pacific Northwest Utilities Conference Committee.

Minidoka Reservoir inundated nearly 8,000 acres of sagebrush-grasslands. This type of habitat provides critical food and cover for big game and sage grouse, as well as supporting numerous nongame species. Inundation of the reservoir area, and extensive conversion of sagebrush habitat in the surrounding area to irrigated croplands and crested wheatgrass, has created a need to protect and enhance remaining sagebrush habitat.

In addition, Minidoka Reservoir inundated over 36 miles of riverine and riparian habitat, which contained an estimated 935 acres of willow-dominated and emergent wetlands, and nearly 3,900 acres of river otter habitat. Some high quality emergent wetlands have become established around the reservoir, and migratory redhead habitat has been improved. However, there has been a net loss of 396 acres of willow-dominated wetlands, and river otters no longer exist in the reservoir area. Wildlife values associated with riparian systems in southern Idaho are substantial, and it is important to protect and enhance remaining areas of riverine and wetland habitat.

March 31, 1989
John Palensky
Page 2

In summary, we support the Wildlife Impact Assessment and recommend the development of a mitigation plan to address means of protect1 ng, mitigating, and enhancing wildlife.

Sincerely,

Jerry Mallet

for Jerry M. Conley
Director

JMC/RCM/sa

Enc.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
BOISE FIELD OFFICE
4696 Overland Road, Room 576
Boise, Idaho 83705

February 17, 1989

FEB 22 1989

Jerry Conley, Director
Headquarters
Idaho Department of Fish and Game
P.O. Box 25
Boise, Idaho 83707

Dear Mr. Conley:

The Boise Field Office of the Fish and Wildlife Service has reviewed the draft report for Minidoka Dam Wildlife Impact Assessment.

During assessments, your technical staff met and coordinated with all the agencies involved and interested in the projects. We believe they did an in-depth evaluation using the available information and techniques. The wildlife and wildlife habitat losses they cite in the report represent the best estimates for actual losses and should be used as the basis for determining mitigation goals. We recommend developing a mitigation plan to compensate for losses identified in the Minidoka Dam Impact Assessment.

Sincerely yours,

Walter D. Ray
for Charles H. Lobdell
Field Supervisor

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

Burley District
Route 3, Box 1
Burley, Idaho 83318

IN REPLY REFER TO: 6500

March 8, 1989

Idaho Dept. of Fish & Game
Jerry M. Conley, Director
600 South Walnut
P.O. Box 25
Boise, ID 83707

Dear Mr. Conley:

In response to the Department's request for comments on the Draft Report for the Minidoka Dam and Reservoir Wildlife Impact Assessment, we would like to express our approval of the contents in the document. We have not identified any problems or errors in its content.

Also, in reviewing the summary of impacts (Table 10) on target species, we feel the loss of habitat units in the upland and riverine habitats warrant further efforts in mitigation planning. Of the four target species showing a loss of habitat units, three of these species (yellow warbler, river otter, and sage grouse) have experienced significant habitat losses or degradation in the past. Efforts to mitigate for losses of these habitats should continue.

Sincerely,

Gerald L. Quinn

Gerald L. Quinn
District Manager

cc: Northwest Power Planning Council
Peter Paquet

The SHOSHONE-BANNOCK TRIBES

FORT HALL INDIAN RESERVATION
PHONE (208) 238-3700
(208) 785-2080
FAX # (208) 237-0797

FORT HALL BUSINESS COUNCIL
P. O. BOX 306
FORT HALL, IDAHO 83203

FEB 2 2 1989

February 17, 1989

Mr. Jerry M. Conley, Director
Idaho Department of Fish & Game
600 South Walnut, Box 25
Boise, Idaho 83707

Dear Mr. Conley:

The Shoshone-Bannock Tribes have reviewed the Draft Report for the Minidoka Dam and Reservoir Wildlife Impact Assessment. We concur with the findings in the Assessment concerning losses and benefits to wildlife resulting from project construction and operation. The interagency team which prepared the document utilized the best professional expertise and techniques available. The team produced a valid and useful report which establishes a firm, well documented foundation upon which to base mitigation planning and implementation.

We urge that work begin immediately to identify the most effective, cost-efficient mitigation measures best suited to replacing the losses that have occurred to wildlife at Minidoka.

Sincerely,

Velda A. Auck

Velda Auck
Fort Hall Business Council

United States Department of the Interior

BUREAU OF RECLAMATION
PACIFIC NORTHWEST REGION
FEDERAL BUILDING & U.S. COURTHOUSE
BOX 043-550 WEST FORT STREET
BOISE, IDAHO 83724-0043

TAKE PRIDE IN AMERICA

IN REPLY
REFER TO:
PN 151

FEB 27 1989

Mr. Jerry Conley
Director
Idaho Fish and Game
P.O. Box 25
Boise ID 83707

Subject: Wildlife Impact Assessment Report, Minidoka Dam, Northwest Power Planning Act (Wildlife Study)

Dear ~~Mr. Conley~~ Jerry:

The Bureau of Reclamation has reviewed the draft wildlife impact assessment report for Minidoka Dam, prepared under the auspices of the Northwest Power Planning Council, and is in agreement with the biological findings reported. Our specific comments on the draft were conveyed to Allyn Meuleman and Bob Martin of your staff at a meeting of the interagency team held in the Jerome, Idaho, Fish and Game office on February 16, 1989.

At the interagency meeting on the 16th, it was requested that each agency inform Idaho Fish and Game whether it supported the Northwest Power Planning Council's development of a mitigation plan to address the identified habitat losses. We do support the development of a mitigation plan and look forward to working with you and your staff on that plan.

Sincerely,

John W. Keys, III

Regional Director

cc: Project Superintendent, Burley ID, Attention: 100, 422